

HISTORY & EVOLUTION OF EDGEWISE ORTHODONTICS

RAJEEV KUMAR MISHRA

The beginning

The Edgewise arch mechanism was Edward H. Angle's last and greatest contribution to orthodontics, after a lifetime devoted to development of orthodontic appliances.

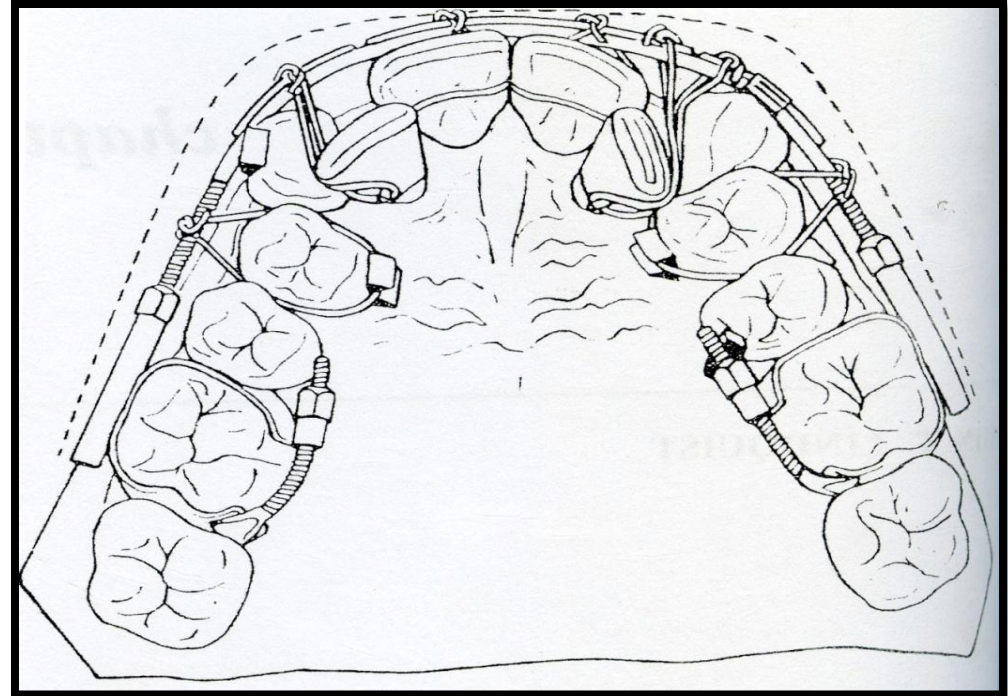
Lindquist J T. The Edgewise appliance. In: Graber T M, Swain B F, editors. Orthodontics current principles & techniques. The C.V. Mosby company ;1985

The Predecessors

Angle E arch(1900)

Design features

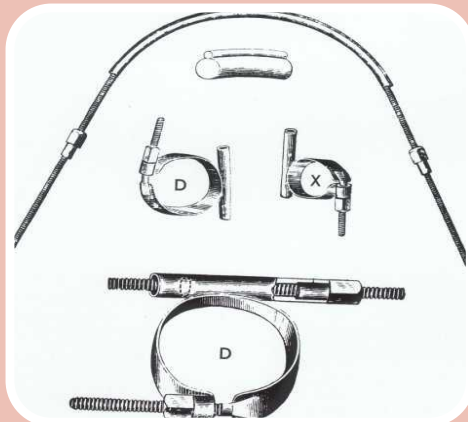
- Used a threaded labial arch for expansion and ligatures to move teeth to archwire.
- Only molars were banded
- Ligatures of .0036"-.006" used



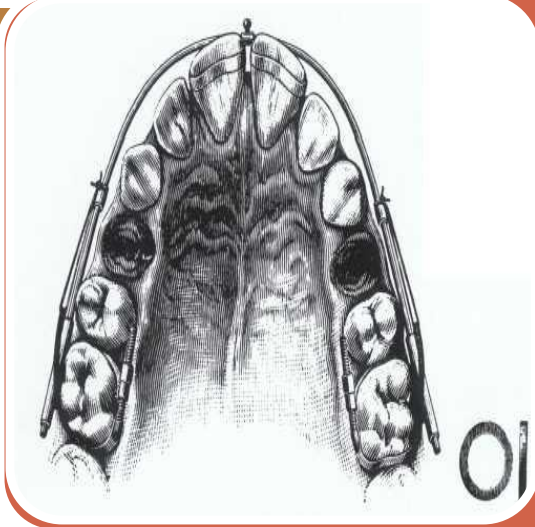
The heavy arch wire was supplied in four designs depending upon treatment planned



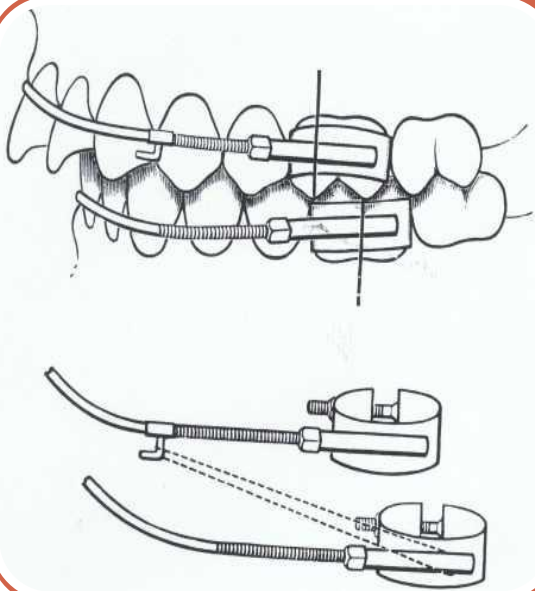
This basic E arch was used in the mandible with Baker anchorage



The ribbed end E arch was used in expansion by tying brass ligatures to the arch



The E arch without threaded ends that fit into the molar sheaths was used with an attached ball for high-pull headgear in the incisor area



The E arch with hooks in the maxilla moved the entire maxillary dentition distally and the mandibular dentition mesially by the action of intermaxillary elastics

Limitations

- Only tipping movements were permitted
- Can deliver only heavy interrupted force
- Correction of the axial relationships of the teeth could not be accomplished

Vaden J L, Dale J G, Klontz H A. The Tweed-Merrifield Edgewise appliance: Philosophy, Diagnosis and Treatment. In : Graber T M, Vanarsdall R L, editors. Orthodontics Current principles and technique. 3rd ed. Mosby; 2000

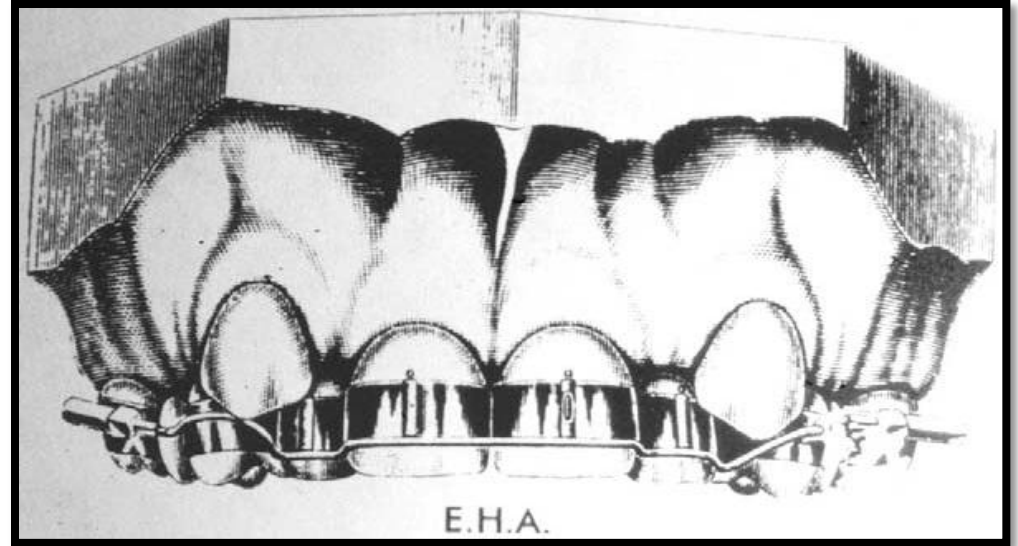
Proffit W R, Fields H W, Sarver D M, editors. Contemporary Orthodontics. 4th Edition. 2010

Wahl N. Orthodontics in 3 millennia. Chapter 5: The American Board of Orthodontics, Albert Ketcham, and early 20th-century appliances. Am J Orthod Dentofacial Orthop 2005;128:535-40

Design features

- This appliance used vertical tubes & gold and platinum bands on most of teeth.
- Pins soldered to the labial arch wires engaged by tubes that were soldered to bands on individual teeth
- First appliance with a mechanism for root movement.

Pin & tube appliance (1910)



Wahl N. Orthodontics in 3 millennia. Chapter 5: The American Board of Orthodontics, Albert Ketcham, and early 20th-century appliances. *Am J Orthod Dentofacial Orthop* 2005;128:535-40

Vaden J L, Dale J G, Klontz H A. The Tweed-Merrifield Edgewise appliance: Philosophy, Diagnosis and Treatment; *Orthodontics Current principles and technique*. Graber T M, Vanarsdall R L. 3rd edition. 2000

Limitations

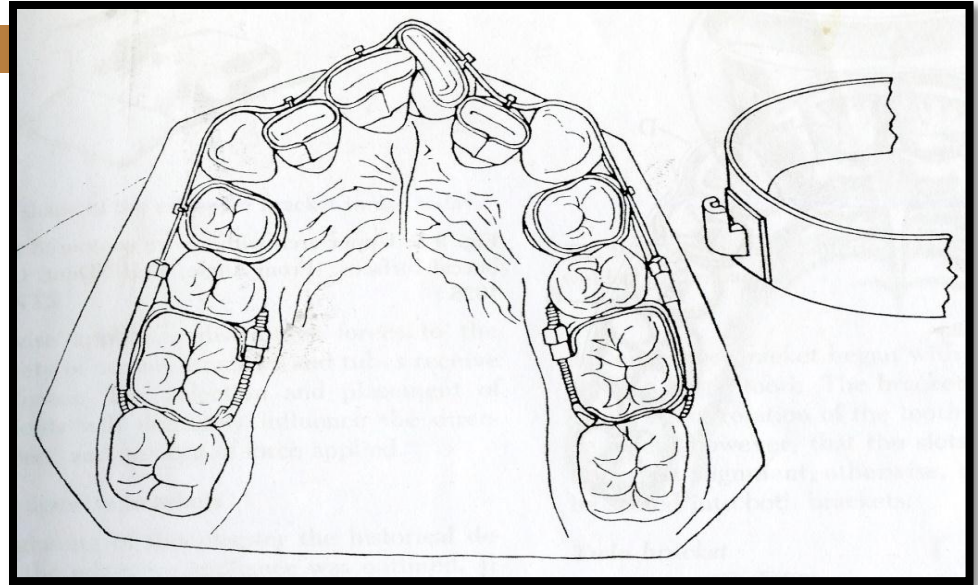
- Too difficult to master the use
- Soldering and unsoldering at each adjustment was time consuming and tedious.
- Heavy base arch lead to poor spring qualities
- No control of tooth roots
- Frequent activation was required

Wahl N. Orthodontics in 3 millennia. Chapter 5: The American Board of Orthodontics, Albert Ketcham, and early 20th-century appliances. *Am J Orthod Dentofacial Orthop* 2005;128:535-40

Proffit W R, Fields H W, Sarver D M ,editors. *Contemporary Orthodontics* .4th Edition.2010

Vaden J L,Dale J G,Klontz H A.The Tweed-Merrifield Edgewise appliance:Philosophy ,Diagnosis and Treatment; *Orthodontics Current principles and technique*. Graber T M ,Vanarsdall R L.3rd edition.2000

Ribbon arch appliance(1915)




Design features

- Brackets were introduced with this new appliance
- Vertically positioned rectangular slot behind the tube
- The ribbon arch , of .022 x .036-in gold, was held firmly with brass pins.
- Like its predecessors, the ribbon arch had threaded ends

Limitations

- Mesiodistal axial movement difficult to obtain
- Too flexible to allow precise positioning of roots
- Lacked premolar control and ease in seating between the horizontal molar tubes and the vertical bracket slots.
- Size itself did not provide the stability thought necessary for stabilization or anchorage of posterior teeth.




Angle corrected anterior crowding by advancing the crown of incisors. For a long time he hoped the apices would follow spontaneously. Then because of uncertainty of this reaction , he started his quest for an appliance that would be able to accomplish root movement.

Philippe J. Journal of Dentofacial anomalies and orthodontics 2008;11(1):68-74

The Edgewise appliance

To overcome the drawbacks of the ribbon arch, in 1928, Angle reoriented the slot from vertical to horizontal and inserted rectangular wire “edgewise”-with its greater dimension perpendicular to the long axis of the teeth

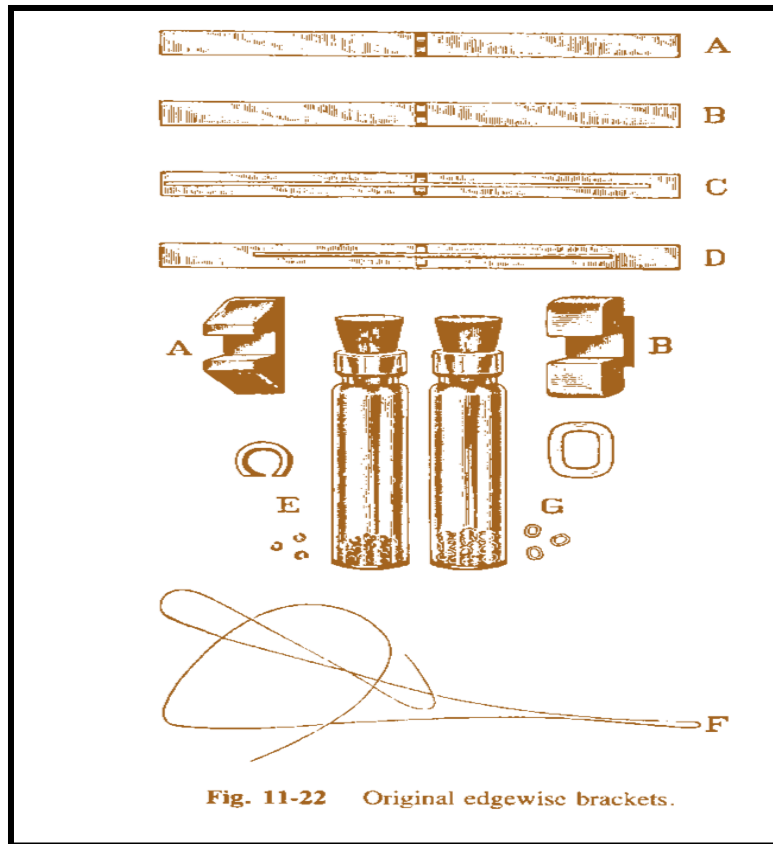
Wahl N. Orthodontics in 3 millennia. Chapter 5: The American Board of Orthodontics, Albert Ketcham, and early 20th-century appliances. Am J Orthod Dentofacial Orthop 2005;128:535-40



Rather than being held with lock pins, which often broke and defied removal, the archwire was tied in place initially with brass ligature and later by stainless steel wire ligature. To correct rotations, three-quarter rings were soldered off-center on the bracket.

The archwire, as well as the bands and brackets, was of .022 x .028-in gold.(0.56mm x 0.71mm)

The edgewise appliance was the first appliance able to move teeth in all 3 planes simultaneously.



Original Edgewise brackets, including obsolete wingless brackets(A), washers, staples and ligature wire

Angle, E .H. The latest and best in orthodontic mechanism. Dent Cosmos 1928;70:1146

The edgewise mechanism was designed to allow the orthodontist to place the teeth into Angle's concept of "line of occlusion" defined as

the line with which ,in form and position according to type,the teeth must be in harmony if in normal occlusion.

Major steps in evolution of the Edgewise appliance

1. Automatic rotational control
2. Alteration in bracket slot dimension
3. Straight wire prescription

Proffit WR, Fields HW, editors. Contemporary orthodontics. 4th ed. Saint Louis: Mosby; 2000.

Evolution of bracket

Original Edgewise bracket

- Developed from ribbon arch
- Soft gold, soldered to gold band material
- Wingless 0.050" in width
- Bracket slot 0.022" x 0.028"
- Archwire not resting on band but on the bottom of slot

Drawback

Bracket slot was readily deformed by the forces of occlusion and by tying ligature wires to the bracket.

Lindquist J T. The Edgewise appliance. In: Graber T M, Swain B F, editors. Orthodontics current principles & techniques. The C.V. Mosby company; 1985

Various modifications of edgewise brackets

Single Width Bracket

It was designed to overcome the problem of tooth rotation. Soldered gold eyelets was placed in the bands.

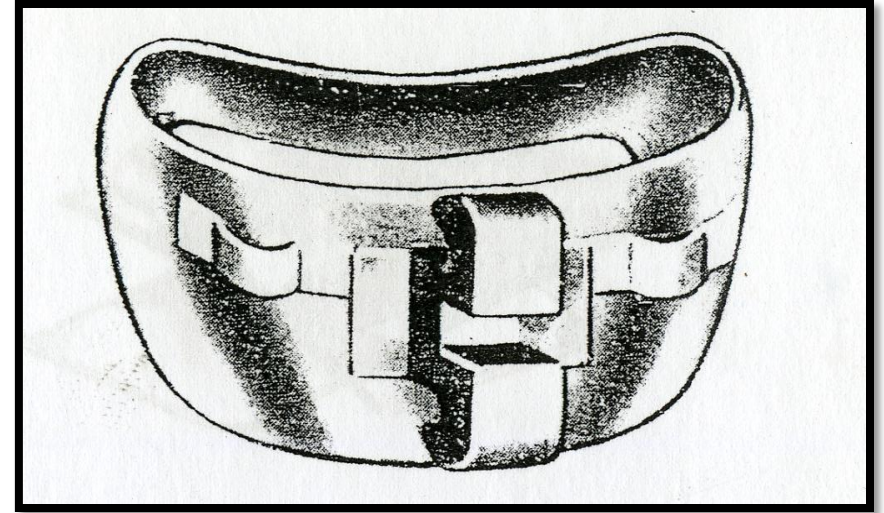
Ligature wire tied from eyelet to the archwire rotated the tooth by means of deflection of the archwire and compression of periodontal ligament.

Lindquist J T. The Edgewise appliance. In: Graber T M, Swain B F, editors. Orthodontics current principles & techniques. The C.V. Mosby company ;1985

Drawback

Continued tying of ligature to eyelet was required through out treatment which was time consuming and inefficient.

Lindquist J T. The Edgewise appliance. In: Graber T M, Swain B F, editors. Orthodontics current principles & techniques. The C.V. Mosby company ;1985



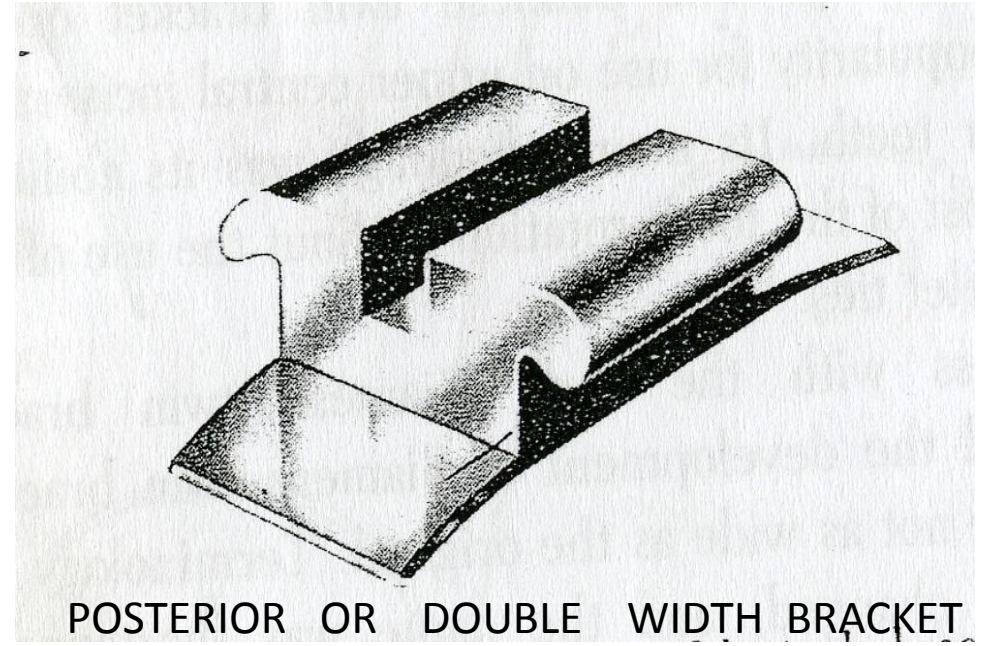
SINGLE WIDTH ANTERIOR EDGEWISE
BRACKETS WITH EYELETS WELDED TO BAND

Double width /Posterior bracket

Approximately twice as wide as single width bracket (0.1 in)

Designed for use on molar teeth, it has been practically used on all tooth.

Lindquist J T. The Edgewise appliance. In: Graber T M, Swain B F, editors. Orthodontics current principles & techniques. The C.V. Mosby company ;1985



Twin Bracket (1952)

- Two edgewise brackets joined on a common base.
- Named "Siamese twin brackets" by Swain, the originator of idea.
- The space between the two brackets was approximately 0.050", equal to the width of one of the brackets.

Available in four sizes

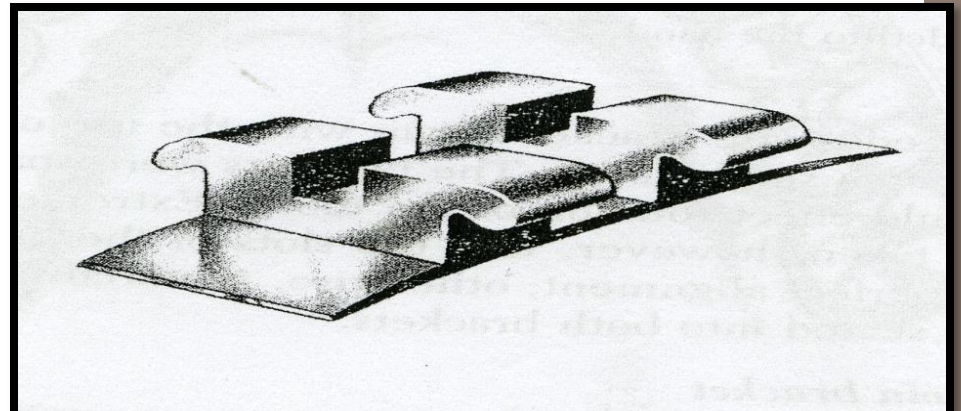
Junior/junior Siamese- For mandibular incisors

Medium /Intermediate Siamese-For canine and premolars

Wide /Standard Siamese- For maxillary incisor

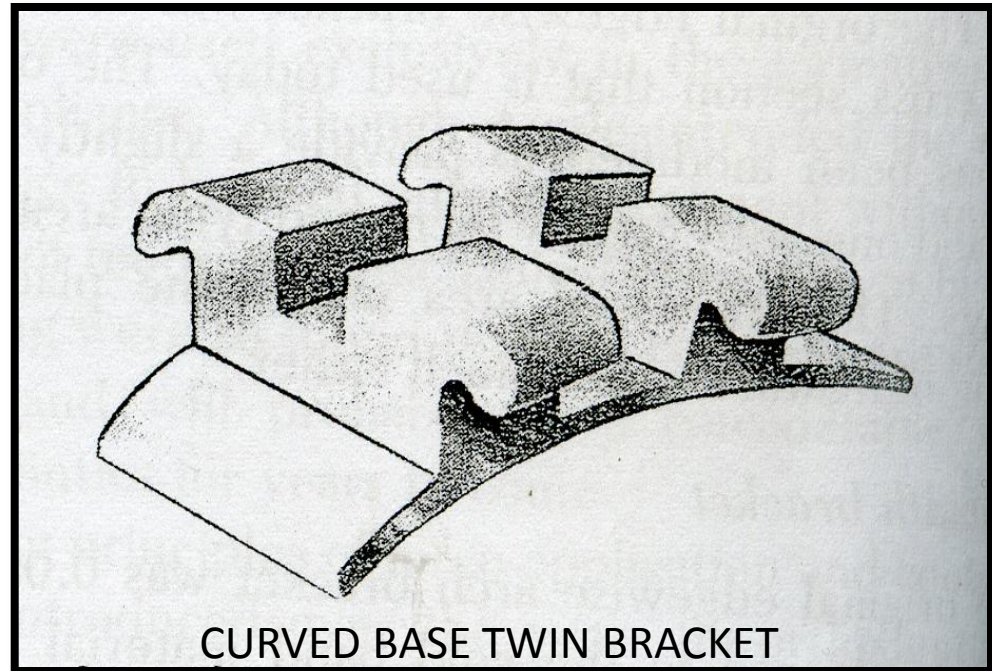
Extra large

Kharbanda O P. Components of contemporary fixed orthodontic appliance.In:Kharbanda O P,editor.Orthodontics Diagnosis and management of malocclusion and dentofacial deformities.1st ed.Elsevier;2009



Curved base twin bracket

Base of twin bracket was curved to conform to the curvatures of canine and premolars



CURVED BASE TWIN BRACKET

Advantages

- Auxiliary eyelet tie was not required for rotation
- Greater control of axial inclination
- Positive control

Lindquist J T. The Edgewise appliance. In: Graber T M, Swain B F, editors. Orthodontics current principles & techniques. The C.V. Mosby company ;1985

Disadvantages

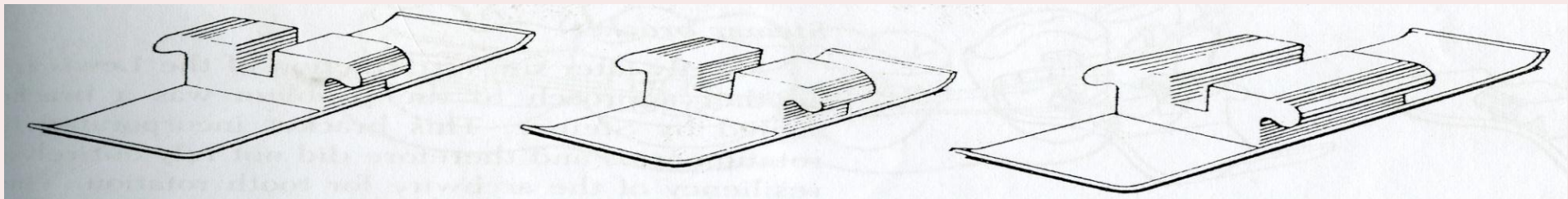
- Decreased interbracket span - Decreased resiliency of archwire
- Decreased amount of activation of closing loops

Lindquist J T. The Edgewise appliance. In: Graber T M, Swain B F, editors. Orthodontics current principles & techniques. The C.V. Mosby company ;1985

Lewis Bracket

Original Lewis bracket consists of soldered auxiliary rotation arms or wings abutted against the bracket itself and thus offered a lever arm to deflect the archwire and rotate the tooth.

Present Lewis bracket is a one piece rotational bracket with integral rotational wing



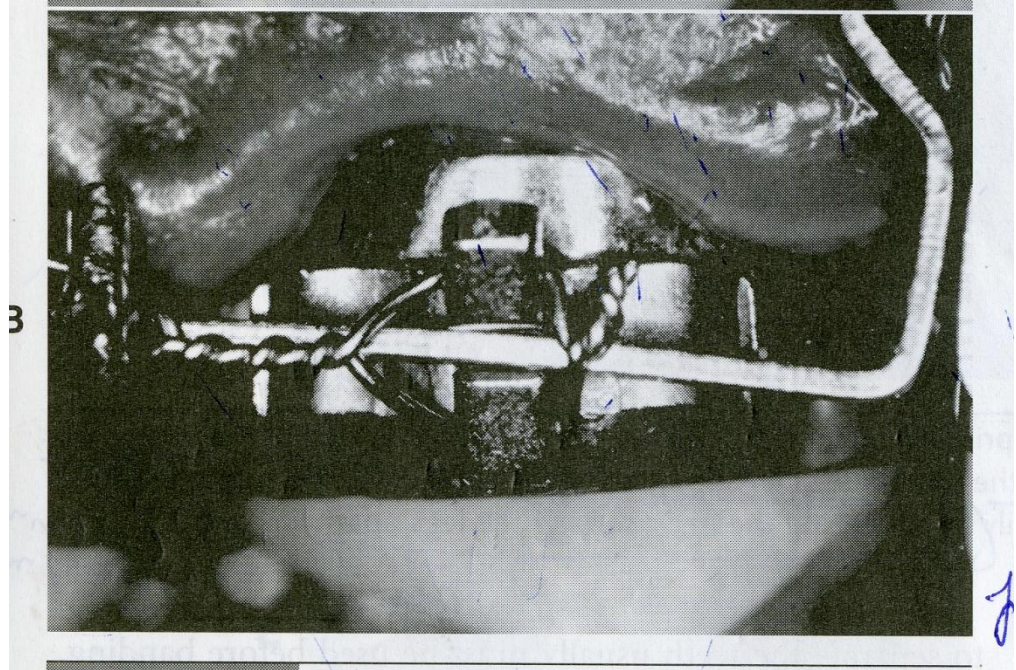
Advantages

- 100% of desired rotation is easy to obtain
- No interference with occlusogingival deflection of wire ,hence no decrease in interbracket wire span
- No interference with activation of closing loops, second order bends and other archwire fabrications

Disadvantage

Size of the bracket hindered use in many situations

Food trapping around the wings



Modifications of Lewis Bracket

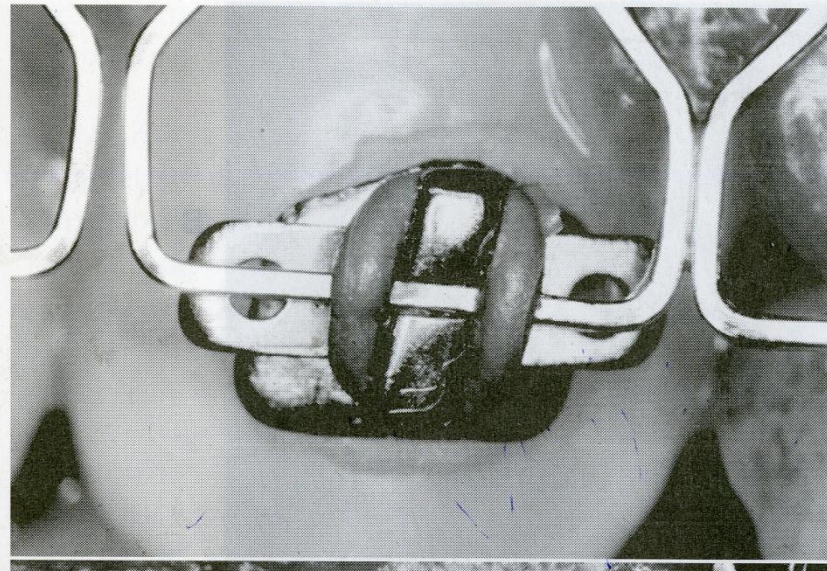
- Curved base Lewis bracket

- Vertical slot Lewis bracket

Consists of 0.020x0.020 in vertical slot , making possible the use of uprighting spring to correct axial inclination

- A modification of the Lewis bracket, designed by Howard M. Lang (1914-94),³ uses straight arms with a hole to increase flexibility and for ligature tying.

Proffit W R, Fields H W, Sarver D M, editors .Contemporary Orthodontics. 4th Edition.2010



Broussard Bracket

- Developed by Garford Broussard
- A conventional bracket with a closed, rectangular, vertical slot 0.018" X 0.046" which is formed when the bracket is welded onto the band material

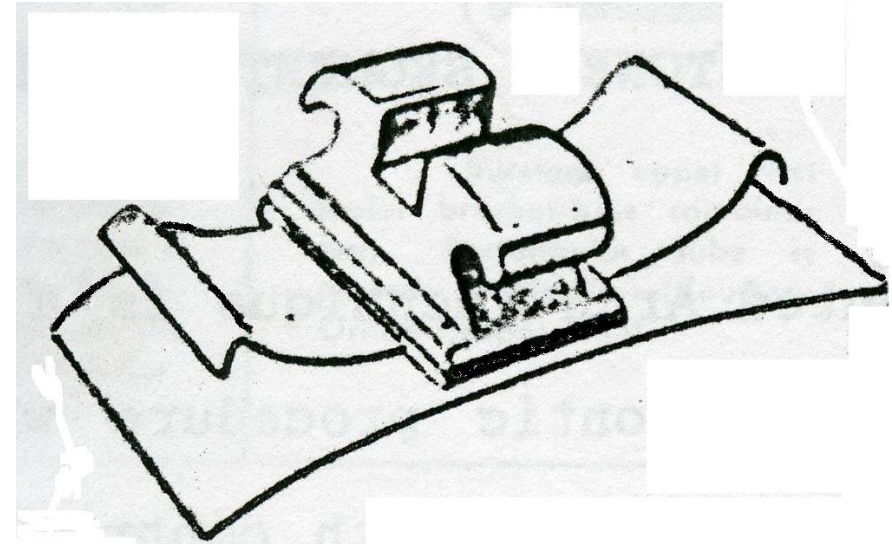


Steiner Bracket

This bracket incorporated flexible rotation arms which afforded a rotational effect

Easy to tie

It works satisfactorily as long as the flexible arms do not take on a permanent deformation.





The list of bracket modification is almost endless


Lindquist J T. The Edgewise appliance. In: Graber T M, Swain B F, editors. Orthodontics current principles & techniques. The C.V. Mosby company ;1985

Change in slot

Change in slot size

Steiner(1953) brought out the first .018 x .028-in bracket to accommodate a like-dimension, stainless steel archwire, greatly improving the elasticity (and comfort) of working wires.

Today most Edgewise brackets have slot dimension of 0.018x0.028 or 0.022x0.028 in.

- 
- The original 22-slot bracket is quite versatile.
 - Angle's appliance was engineered to produce appropriate force with 22x28 gold arch wire but when stainless steel archwire was introduced Angle's original calculation was no longer valid because steel wire of same size was so much stiffer
 - A reduction in slot size was advocated for this purpose.

Proffit W R, Fields H W, Sarver D M, editors .Contemporary Orthodontics. 4th Edition.2010

Hocevar R A. Why edgewise?A compendium of means to gentleresilient fixed appliances.Am J Orthod.1981;81(3):237-55

Evolution of appliance material

- Precious metal
- Stainless steel -introduced in dentistry in 1930s
 - Stamped Bracket-Inexpensive
 - Cast bracket- More accurate & durable

Titanium as alternative to Stainless steel

Contains no nickel and is exceptionally biocompatible

Titanium archwires are being used since 1980s.

Reduced rate of bond failure

Plastic brackets

Introduced in 1960s

Drawbacks

- Staining & discolouration
- Poor dimensional stability
- Friction between plastic bracket and metal archwire

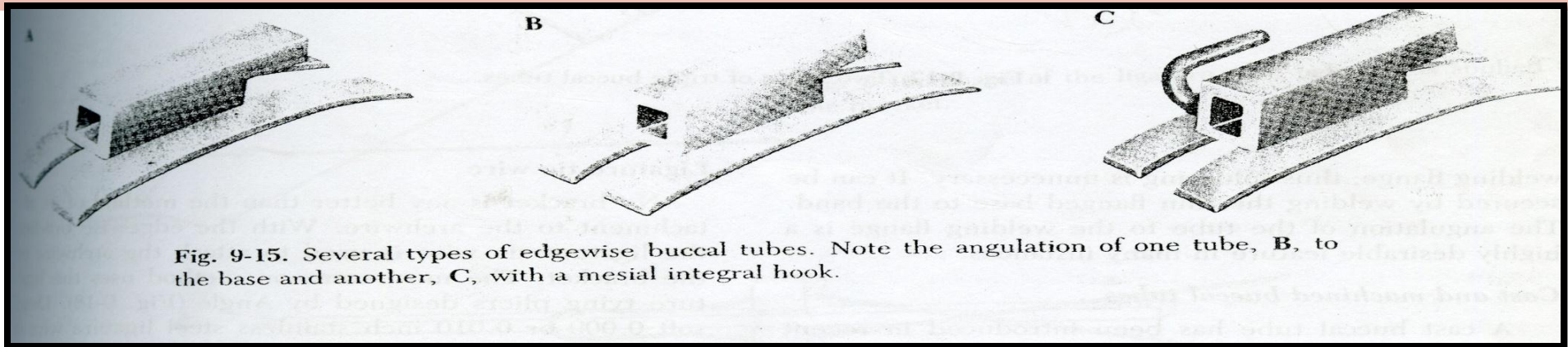
Ceramic brackets

- Available commercially from late 1980s
- Quite durable and resist staining
- Can be custom molded for individual teeth
- Drawbacks
 - Brittle –prone to fracture
 - High friction on bracket slots
 - Wear on teeth contacting a bracket
 - Enamel damage from bracket removal

Evolution of Edgewise buccal tubes

Original Edgewise buccal tube was a piece of 0.022x0.028 inch gold or nickel silver tubing

Most commonly used length was 3/16-1/4 in.



Modifications

- Notched distal end- to facilitate placing a ligature wire around the distal end of tube to make a tieback ligature
- Elastic hook- To aid in attachment of elastic band
- Cast and machined buccal tube
- Combined buccal tube
- Triple buccal tube

Lindquist J T. The Edgewise appliance. In: Graber T M, Swain B F, editors. Orthodontics current principles & techniques. The C.V. Mosby company ;1985

Cast and machined buccal tube

- Has been introduced in recent years
- The one piece casting is available in single and multiple tube varieties.
- Buccal tubes are also being machined like brackets and then enclosed by means of caps welded on them with a laser beam

Combined buccal tube

Consists of an additional round tube which can be used for insertion of a facebow appliance or auxiliary round archwire.

Should be rigid to prevent deformation from the forces of occlusion and the wear of archwire in it

Triple buccal tube

- Consists of 2 rectangular and 1 round tube
- The additional rectangular tube is for the auxiliary sectional or base archwire used in some technique

Lindquist J T. The Edgewise appliance. In: Graber T M, Swain B F, editors. Orthodontics current principles & techniques. The C.V. Mosby company ;1985

Building treatment into the Edgewise appliance

Bracket angulation

In the series of articles introducing edgewise appliance, Angle recommended bracket slot to be parallel to band strips. However in the same series of article he suggested angulating posterior bracket to produce desired tooth movement

The general rule in early days of edgewise appliance was to place the band strip on the teeth with bracket parallel to long axis of teeth.

Tweed in 1941 pointed out the shortcoming of this approach and advocated use of "artistic positioning" bends to obtain correct axial inclination.

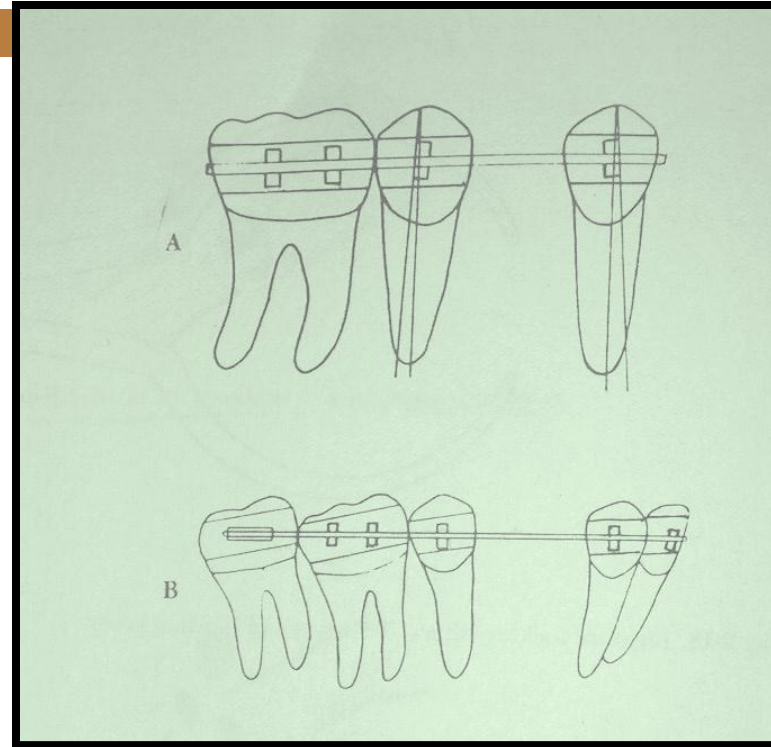
Holdaway method

Holdaway described three uses for bracket angulation

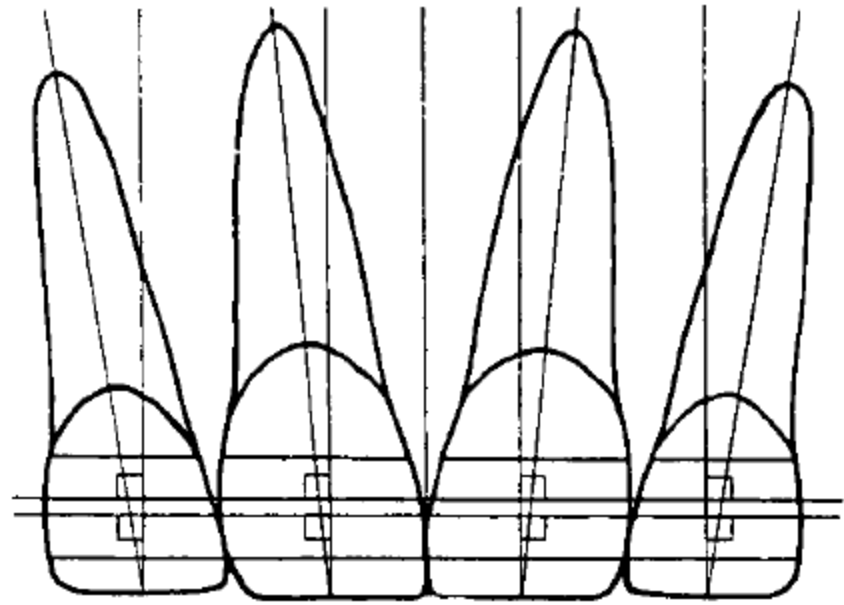
As an aid in paralleling root adjacent to extraction spaces placement of bracket so that their greatest dimension is angulated at 3° towards the extraction space.

Holdaway R H. Bracket angulation as applied to edgewise appliance. Angle Orthod 1952;22:227

- As a method of setting up posterior anchorage units into tipped back or anchorage prepared positions



- On anterior teeth to obtain correct axial inclination or artistic positioning



Torqued bracket slot

- Introduced by Ivan Lee in 1960
- were designed to eliminate the need for adding torque to anterior portion of upper archwire

Lindquist J T. The Edgewise appliance. In: Graber T M, Swain B F, editors. Orthodontics current principles & techniques. The C.V. Mosby company ;1985

Raised base upper lateral brackets

Introduced in 1960s .

Had a raised base of approximately 0.016 in.

To eliminate the need for lateral offset bends.

Lindquist J T. The Edgewise appliance. In: Graber T M, Swain B F, editors. Orthodontics current principles & techniques. The C.V. Mosby company ;1985

Contemporary brackets & tube

Modern edgewise appliance use brackets or tubes that are custom made for each tooth with the goal of minimizing the number of bends in archwire needed to produce an ideal arrangement of the teeth-hence the straight wire name.

Proffit W R, Fields H W, Sarver D M, editors .Contemporary Orthodontics. 4th Edition.2010

Compensations for first order bends

For anterior and premolars-varying the bracket thickness eliminates in-out bends in anterior position of each wire

For molars –offset position of molar tubes is necessary

- The tube or bracket specified for the upper molars should have at least 10-degree offset
- The offset for lower first molar should be 5-7 degree while that for second molar should be at least as large as for the upper molar

Compensation for second order bend


- Contemporary Edgewise brackets have a built –in tip for maxillary incisor teeth which varies among the appliance that are now available.
- A distal tip for upper first molar is also needed to produce good interdigitation of the posterior teeth.

Compensation for third order bend

- By placing torque in the bracket by cutting bracket slot into the bracket at an angle
- The amount of torque recommended in the various appliance prescription varies more than any other feature of contemporary Edgewise appliance

Andrews Prescription

- Introduced by Andrews(1971)
- Based on six keys to normal occlusion proposed by him
- The most basic is Andrews' concept of placing brackets on L-A ,which he describes as the mid-point of the clinical crown's long axis.



- If imitation is highest form of flattery, then Andrews should feel good.

- Not many years passed before several manufacturers came out with preadjusted Edgewise appliance of their own

Contribution of Tweed

- Angle gave Orthodontics the Edgewise bracket but Tweed gave the specialty the appliance.
- He gave 42 years of his life, from 1928(year of graduation) to his death in 1970 , to the advancement of Edgewise appliance.

Most notable among his many contributions are

- Emphasized facial esthetics
- Developed concept of uprighting tooth over basal bone with emphasis on mandibular incisors
- Made extraction of teeth for orthodontic correction acceptable
- Enhanced clinical application of Cephalometrics
- Developed diagnostic “facial triangle”
- Developed concept of orderly treatment procedure and introduced anchorage preparation as a major step in treatment
- Developed a fundamentally sound and consistent preorthodontic guidance program using serial extraction of primary and permanent teeth

Ever since Edward Angle introduced his edgewise appliance in 1928, orthodontic innovators have been working to improve on not only its original design, but also the method of attachment. The “strap-ups” have evolved from banding to bonding, from labial to lingual, and from metallic to clear. **But, as Angle would be pleased to learn, we still call it edgewise.**