



EVOLUTION OF ORTHODONTIC BRACKETS

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ABSTRACT

The introduction of brackets marked a significant shift in orthodontics, as they allowed for greater control and precision in tooth movement. The Ribbon Arch bracket designed by Angle was a significant innovation, paving the way for further advancements in bracket design. Dr. Ronald H Roth's contribution to bracket design through clinical trial and error is noteworthy. His work led to the development of a more effective appliance, which has undergone further modifications over time. Understanding the evolution of orthodontic brackets and their advantages and disadvantages is essential for orthodontic practitioners. This knowledge can help them select the most suitable bracket for their patient's treatment plans. It is also important to conduct further research on the biocompatibility, aesthetics, and treatment outcomes of various bracket types to make informed decisions that can lead to better patient outcomes.

INTRODUCTION

Attempts to treat malocclusion started as early as 1000 BC. Aulus Cornelius (25 BC – 50 AD) suggested finger pressure to align the teeth for correction of malocclusion.

The term “Bracket” came into use when Dr. Edward .H. Angle introduced the Ribbon Arch appliance in 1916. This bracket is put on the band close to its gingival margin and

has a vertical slot facing occlusally. Death of Angle saw a new beginning, with the evolution of different bracket systems. Some of the contributions were Steiner, Holdaway, Jarabark, Frizell, Ricketts, Tweed, and many others.¹

During the middle of the last century and a half, Dr. P.R. Begg of Adelaide, South Australia was the major contributor. The design of the brackets is very important for precise tooth movement and control of forces acting when an appliance is worn by the patient. There are a large number of bracket designs meant to perform various tooth movements such as tipping, translation, and torque. These brackets form the basis of all orthodontic prescriptions.

Brackets may be made from stainless steel, Gold, Titanium, Cobalt-Chromium, Polycarbonate, Fiberglass, Ceramic, Magnetic, and metal-reinforced plastic brackets. These brackets vary in factors like bond strength, friction, and fracture resistance. Brackets also differ in their dimensions and slot size. These factors regulate treatment mechanics to a great extent. Thus, the wave of bracket design changes continues to increase, as a variety of brackets are available. The armamentarium of brackets for the present-day orthodontist is formidable.

CLASSIFICATION OF ORTHODONTIC BRACKETS

i) Based on the attachment to the tooth surface :

- A) Weldable
- B) Bondable
 - 1) Laminated mesh
 - Regular
 - Mini
 - Open mesh
 - 2) Porous powder
 - 3) Honeycomb – micro lock
 - 4) Chemically treated

ii) Based on material :

- 1. Stainless steel
- 2. Polycarbonate
- 3. Fiberglass reinforced
- 4. Ceramic
 - A) Alumina based
 - a) Monocrystalline
 - b) Polycrystalline
 - B) Zirconia-based brackets
- 5. Titanium brackets
- 6. Magnetic brackets

7. Cobalt-chromium brackets

8. Composite brackets

III) Based on technique :

1. Edgewise bracket
2. Straight wire bracket
3. Begg light wire bracket
4. Brackets used in combination technique
5. Universal bracket
6. Twin-wire bracket
7. Brackets used in BEDDTIOT
8. Tip-Edge bracket
9. Brackets used in Vari-Simplex Discipline
10. Brackets used in lingual orthodontics

IV) Based on bracket archwire contact:

- A) Ligating brackets
- B) Self-ligating brackets
 1. Swirl lock bracket
 2. Ford lock bracket
 3. Slide pin bracket
 4. Russel lock bracket
 5. Edge lock bracket
 6. Speed bracket
 7. Activa bracket

V) Based on the bracket manufacturing process:

- 1) Milled bracket
- 2) Cast bracket
- 3) Moulded and sintered brackets

1)EVOLUTION OF THE EDGEWISE APPLIANCE

In 1887, Angle gave the first bracket appliance which had a metal tube soldered to the band. The issues faced by him led him to develop a standard system. Angle gave four appliance systems;

THE E-ARCH APPLIANCE (1907)-The E- Arch introduced in 1887, was a modification to the basic design of tying the rigid framework to the teeth. Clamp bands were used in the appliance formation. These clamp bands had a metal band that encircled the tooth crown. Each end was bent outward abruptly, perforated, and thickened. The perforation in one flange was threaded, and a screw passed through it. The shaft or screw when turned, tightened the band around the tooth.

PIN AND TUBE APPLIANCE (1910)- Brackets with bands on most of the teeth were the first time used in this appliance. All teeth had bands with vertical tubes and pins

soldered to them. Tooth movements were achieved by making changes to the pins.

RIBBON ARCH APPLIANCE (1915)- This appliance was changed by placing a vertically positioned rectangular slot behind the tube. Issues with pin and tube appliances led to its discovery in 1915. It had a bracket with a vertical slot and the brass pins secured the wire.

THE EDGEWISE APPLIANCE(1924)- The edgewise appliance was Dr. Angle's final and greatest achievement. The positioning of the slot in the center and the horizontal plane changed the brackets forever and the wire rotated 90° to the orientation of the ribbon arch giving its name 'edgewise'. The new edgewise bracket had a box with 3 walls 0.022 inches by 0.028 inches in dimension with horizontally opening slots. This new appliance was very precise and had a very effective torquing mechanism. Edgewise appliance had control of the axial inclinations of all teeth in all directions.

Modifications of the original edgewise bracket include the original single-width edgewise bracket, two separate brackets on a single tooth, twin brackets posterior bracket, curved base twin bracket, Lewis bracket, anti-tip Lewis bracket, vertical slot Lewis bracket, Steiner bracket, buhrstone's segmented arch technique, universal appliance, The 3-d universal bracket, and twin-wire appliance.

2)EVOLUTION OF THE BEGG LIGHTWIRE BRACKETS

Dr. Raymond Begg gave this appliance. Begg worked with Angle from 1924-25. Begg after returning to Australia practiced the edgewise mechanism with non-extraction philosophy but faced problems with post-treatment profiles and relapses. He stated that the edgewise appliance did not cause rapid closure of expansion spaces or deep bite correction and caused undesired root movements and unavoidable uprighting of mesiodistally tipped teeth. To avoid these issues, Begg discontinued wide-channel brackets and began using ribbon arch brackets, facing the slots gingivally rather than occlusal. A ribbon arch bracket, used with a round archwire, permits free tipping in all directions.

BRACKET CONFIGURATION:

The Begg technique uses modified ribbon arch brackets whose flanges accept a direct bonding pad or can be spot-welded to a band. The archwire slot is 0.020 x 0.045 inches to accept both a 0.020-inch archwire and, when required, a 0.016-inch torquing auxiliary. Two vertical slots, one on either side of the archwire, accept lock pins and/or auxiliaries.

ADVANTAGES-

- The use of light forces is more comfortable for the patient.
- Continuous force application.
- Brackets and tubes have minimum friction of wires.

MODIFICATIONS OF THE BEGGTECHNIQUE

KAMEDANIZED BEGG TECHNIQUE

Dr. Akira Kameda gave this technique. Based on his experience he changed the Begg technique. Dr. Kameda believed that labio-lingual alignment problems compromised most of the issues. Hence tipping teeth mesiodistally as suggested by Begg is wrong and they require correction in the labio-lingual plane. Direction and the magnitude of the tip was the major difference in this technique from Begg's.

TIP EDGE BRACKET AND DIFFERENTIAL STRAIGHT ARCH SYSTEM

The edgewise mechanism with the basic, fixed slots was extremely famous during that period. But even this system had faults like no chance of anterior bite correction or closure of spaces or no chance of correcting A-P interarch defects. Angle's design was made to be modified to achieve a good level of tooth control. In 1986, Dr. P.C. Kesling changed the system to fix all these issues. The change was the removal of diagonally opposing corners of the slot to allow for mesial or distal crown tipping.

REFINED BEGG TECHNIQUE

This technique was introduced by Dr. V. P. Jayade. According to him, no treatment modality is ever perfect. With time its drawbacks become apparent. Unless the treatment evolves to overcome those drawbacks, it is likely to become stagnant and then die slowly. Refinements become necessary to incorporate new concepts and technological progress. The present-day Refined Begg technique evolved from the original teachings of Dr. Begg to overcome the shortcomings of the conventional Begg technique and to assimilate contemporary thinking and material advances.

3)EVOLUTION OF THE STRAIGHT WIREBRACKETS

The title 'Straight-wire concept' was given to focus on the term concept. The main belief was to make an appliance that is precise and effective with less irritation to the patient and reduced efforts and treatment time given by the operator. Also, the control of tooth movement was installed in the bracket rather than the archwire.

In 1958 John J. Stiffer developed an edgewise appliance with male/female components. The female part was attached to the tooth; it was designed to receive one of many interchangeable male components. This was the first edgewise bracket designed to build guidance into all three planes of space. He was granted a US patent for it. However, it was only in 1970 that the first fully programmed appliance was introduced in the field of Orthodontics by Dr. Lawrence F. Andrews.

EDGEWISE APPLIANCE CLASSIFICATION

The several types of edgewise appliances are best differentiated by placing them into three categories:

- **Non-programmed-** This system involved total wire bending and brackets were

the same for all teeth

- **Partly programmed-** This system had brackets that have some built-in features but may require some wire bending.
- **Fully-programmed-** This system had brackets that require no wire bending.

DR. RONALD ROTH'S PRESCRIPTION

- The Roth prescription was devised in 1975 and was marketed commercially in 1976. In the Roth Prescription of the Andrews Appliance, the anterior brackets were placed slightly more incisively from Andrew's "middle of the clinical crown", and the ingredients of those brackets were adjusted accordingly. This was to eliminate the need to place reverse and compensating bends into the finishing wires. The Tru-Arch Form was developed to play a role in this over-correction concept because the arch form affects the rotational positioning of the teeth as well as the brackets.
- Additional hooks on each bracket evolved for the use of short Class II or Class III elastics so that less unfavorable canting of the occlusal plane and less posterior interference would be created with interarch elastics.

VARI-SIMPLEX DISCIPLINE

The Vari-Simplex Discipline was introduced and developed by Dr.R.G. Wick Alexander. His main concern was with simplicity to encourage cooperation, comfort, and control. One of his major goals was to make treatment easier and more convenient for the patient. With these goals in mind, he developed an appliance called the Vari-Simplex Discipline where archwire fabrication is simplified, with first-, second-, and third-order bends placed in the bracket instead of the archwire. Multiloop arches are rarely used. Hooks are rarely soldered to the archwire. Soldering is also time-consuming and can reduce archwire effectiveness. Ligature hooks are used instead, when necessary.

BRANDT TORQUE CONTROL SYSTEM

The new edgewise type bracket and archwire selection permit tip control, sliding mechanics with a straight archwire, and initial continuous programmed torque in the upper front region where it is needed most. The system has a 0.020" slot for the upper anterior teeth for active programmed control of bodily movement and torque of the anterior teeth. It uses a 0.022" slot for the buccal teeth for optimal sliding mechanics.

MCLAUGHLIN, BENNETT, AND TREVISI SYSTEM

McLaughlin and Bennett along with Trevisi changed the entire bracket system to complement their proven treatment philosophy and to overcome the perceived inadequacies of the original SWA. The following changes were made in the standard SWA Brackets:

- Original dots and dashes system for brackets identification was changed to laser numbering of standard metal brackets.
- Brackets were available in standard size metal, mid-size metal, and clear forms.
- The rectangular shape was replaced by a rhomboidal form to reduce the bulk of each

bracket.

4)EVOLUTION OF COMBINATION BRACKETS

BEGG/CHUN-HOON COMBINATION BRACKET TECHNIQUE

This technique was introduced in the early 1960s. It incorporates all the essential features of both the light wire and edgewise techniques. This versatile combination bracket can be used interchangeably with both techniques. Available in regular and curved bases.

MODIFIED FULL-FLANGED COMBINATION BRACKETS:

- The modified version offers gingivally extended welding flanges to provide more area for welding. It allows the archwire to rest completely within the bracket.

MODERN BEGG: A COMBINATION OF BEGG AND STRAIGHT WIRE APPLIANCES AND TECHNIQUES

The FOUR STAGE LIGHT WIRE APPLIANCE introduced by Dr. William J. Thompson in 1981 represents the successful collaboration between Begg practitioners and a manufacturer to produce a machine with beneficial design features that use the advantages while avoiding the disadvantages of both the Begg and the Straight wire appliance. The treatment mechanism is divided into four stages incorporating the usual stages I, II, and III of the Begg technique, and stage IV include finishing with the straight wire appliance.

5)EVOLUTION OF LINGUAL ORTHODONTIC BRACKETS

With the development of brackets that can be directly bonded to the tooth surface, the demand for cosmetic appliances increased even more resulting in clear plastic and tooth-colored ceramic brackets.

1976, Dr. Kurz submitted specific designs and concepts to the U.S. Patent Office for the patent rights to his unique edgewise lingual appliance. Soon after, Dr. Kurz and Ormco started working to change it from a dream to reality. Dr. C. Kurz and his team at Ormco Company have developed seven generations of lingual brackets.

KURZ LINGUAL APPLIANCE

Given by Dr. Craven Kurz in association with Ormco in 1982.

- The brackets were made of stainless steel with a single design, varying in width with each tooth in the arch.
- The brackets had bonded foil/mesh base which was contoured to approximate the lingual morphology of each tooth.
- Since there is such a wide variety of lingual anatomy, additional adaptation is achieved in the laboratory on a custom tooth-by-tooth basis at the time of the indirect bonding setup.
- Brackets have a .018" archwire slot which parallels the occlusal plane.
- Brackets are provided with various degrees of torque, angulation, and bracket thickness.

LINGUAL LIGHT WIRE TECHNIQUE

- This technique was introduced by Dr. Stephen F. Paige in 1982. Interbracket width should be less mesiodistally. Decreased bracket width, mesiodistal root control, and uprighting after extraction closure becomes difficult and the solution is the use of vertical slots for each auxiliary. The torque applied to the tooth is very sensitive because of different morphological surfaces. A small change in position causes a large change in root torque. The solution is indirect bonding procedures by the bracket manufacturer.

CREEKMORE LINGUAL APPLIANCE

Given by Dr. Thomas Creekmore in 1989. Dr. Creekmore believed, an acceptable lingual orthodontic appliance system must align teeth from the lingual aspect as efficiently as a labial appliance, should have an accurate indirect bonding technique, should have special pliers, and selection of preformed archwires with offset torquing keys. His appliance satisfied these criteria.

6)EVOLUTION OF SELF-LIGATING BRACKETS**SELF-LIGATING BRACKETS**

A *self-ligating bracket* is defined as “A bracket, which utilizes a permanently installed, moveable component to entrap the archwire.” Self-ligating brackets may be classified onto two categories: passive and active.

1. PASSIVE BRACKETS:

- The archwire is entrapped by a rigid, moveable component.
- The fit between the bracket slot and archwire controls the tooth.
- Hence undersized archwires compromise tooth control.

2. ACTIVE BRACKETS:

- The archwire is entrapped by a flexible component.
- The archwire is restricted by this flexible component and can store and subsequently release energy through elastic deflection. This causes a light but continuous force that has a precise and controlled tooth movement.

7)EVOLUTION OF BRACKETS BASED ON MATERIALS

Brackets can be classified depending on the materials used for manufacturing them as:

1. Metallic
 - a. Gold alloys
 - b. Stainless steel
 - c. Cobalt Chromium
 - d. Titanium
 - e. Magnetic
2. Plastic

- a. Fibre Glass reinforced
- b. With metal slot

- 3. Ceramic
 - a. Monocrystalline alumina
 - b. Polycrystalline alumina
 - c. Zirconium

CONCLUSION

As a whole, there is no known acceptable bracket system that can treat all types of malocclusions yet there are many prescriptions available which the clinician should judge and make judicious use of it providing a “*Right Treatment for a Right Patient using a Right Appliance at a Right Time*”.

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