

DESIGN AND THE DEVELOPMENT OF A UNIVERSALLY ADJUSTABLE DENTAL BRACKET (BRACES) FOR AN ORTHODONTIC PROCEDURE.

¹ DR. ALKA BANKER, ² DR. AKSHAI AGARWAL, ³ DR. RUPESH VASANI

¹ Diplomat of Indian Board of Orthodontics, Reader- Karnawati School of Dentistry
(Department of Orthodontics)

² Vice Chancellor Gujarat Technology University, Ahmedabad, Gujarat

³ Faculty Dean, Gujarat Technology University & Principal Sal Institute of Technology

alka@pulse-hospital.com , rupeshvasani@yahoo.co.uk

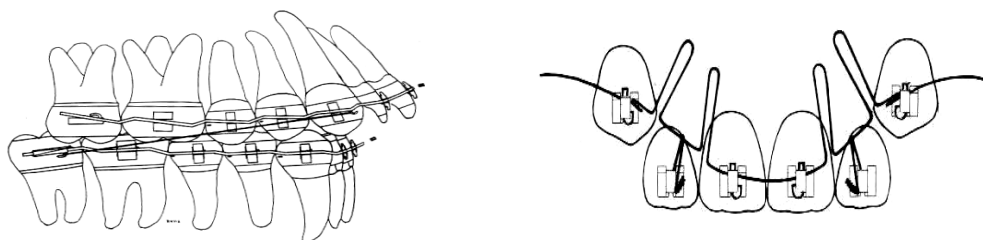
ABSTRACT : Orthodontic braces are currently used to correct malocclusions such as under-bites, overbites, cross bites and open bites, or crooked teeth and various other flaws of teeth and jaws, whether cosmetic or functional. The teeth are actually adjusted by adjusting the wire which passes through the brackets, which are stuck on to the teeth with glue. Once stuck, the bracket is removed only after the problem has been corrected and the procedure is over. The existing design doesn't give the dentist enough flexibility to adjust the inclination of the bracket. The project aims to solve the above problem of non-adjustability by developing innovative ways of making a part of the bracket movable, either mechanically or remotely. This is combined Engineering & Medical approach for the development of a universally adjustable dental bracket (braces) used in an orthodontic procedure. Objective is to design a product which allows universal adjustment of the bracket on the tooth, for the teeth alignment. This control should be with the dentist and it should be possible to readjust every time the patient comes for a visit. Only the orthodontist [not the patient] should be able to adjust the bracket position. The bracket should not change its position in the regular day to day life of the user. Specific step-wise adjustment for the bracket should be possible.

Key Words: Orthodontic Procedures-Treatment Of Straightening Of Crooked Teeth Using Braces; Orthodontist- A Dentist Who Does These Procedures; Bracket- Part Of Dental Braces Which Is Glued On The Tooth; Occlusion- The Way Teeth Connect Together In A Normal Position; Mal-Occlusion- Abnormal Position ,Arrangement, & Joining Of Teeth; Arch Wires - Thin Wires Inserted Into Brackets For Aligning The Teeth.

1. HISTORY:-

The earliest brackets were just a simple slot in the bracket & the gold wires were bent into different shapes to move the teeth¹.

Fig. 1



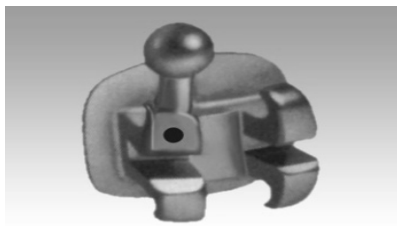
Earliest Brackets

In 1970, Dr. Lawrence F Andrews of San Diego developed the "Straight-wire appliance" inventing the Pre adjusted bracket. There was great excitement about it in the profession & the value it would have in making treatment time shorter, results better & more consistent, & chair side time less for the orthodontist. Andrews developed a system where in the slot was pre-programmed into different angles to achieve a beautiful finish.^{2, 3, 4, 5} This made the wire-bending simpler & treatment goals were easily achieved.

Fig.2



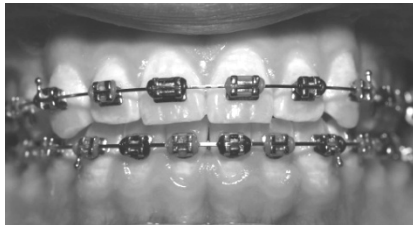
Side view of a pre-adjusted bracket



Front view of a pre-adjusted bracket

Dr. Ronald Roth in 1976 published an article entitled "Five Year Clinical Evaluation of the Andrews Straight-wire appliance".^{6,7} He came to realize that besides pre-adjusted bracket, an efficient mechanism to translate teeth by sliding them on a rectangular-wire was needed. He realized that for teeth to settle into non-orthodontic normal position over-corrections is necessary. A clinical trial & error evaluation over several years resulted in a new prescription of Andrews brackets -the Roth Prescription. MacLaughlin & Bennet further refined the Pre-adjusted systems & objectively pointed out the advantage & dis-advantages of the appliances & out lined factors to be considered in finishing & detailing.⁸

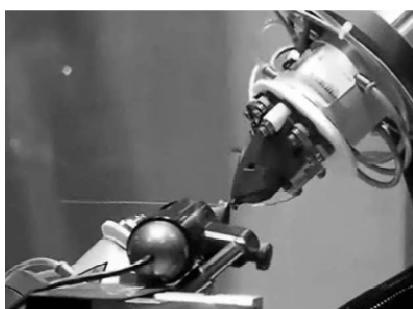
Fig. 3



Orthodontic Appliance (Bracket + Arch wires)

In 2002 Rohit Sachdeva of 'Sure-smile' developed a Robot which uses a scan of the patients mal-occlusion to make a wire, bend in to different shapes to achieve the dental goals.^{9,10} Beautiful finishes were achieved by this method; but the robotic wires were expensive; they look a long time to reach the doctor, if the doctor wanted to change the treatment plan mid-way it was impossible & if the patient broke the wire it was expensive & time consuming to make another wire.

Fig. 4



Sure smile wire bending Robot

For designing and bending arch wires more precisely and rapidly Dr. Alfredo Gilbert in 2011 described a method called LAMDA(lingual Arch Wire Manufacturing and Design Aid)¹¹.The software was developed in the Research and development department of Smile centre dental specialties using the Microsoft Visual Studio 2008 Express integrated environment and Visual C# programming language. **This 3rd generation wire bending robot is designed to be used in the office, thus eliminating both external laboratory fees and the delay in waiting for the wires to be shipped. This robot could bend wires only in one direction (1st order bends), the other two directions could not be managed.

Fig. 5

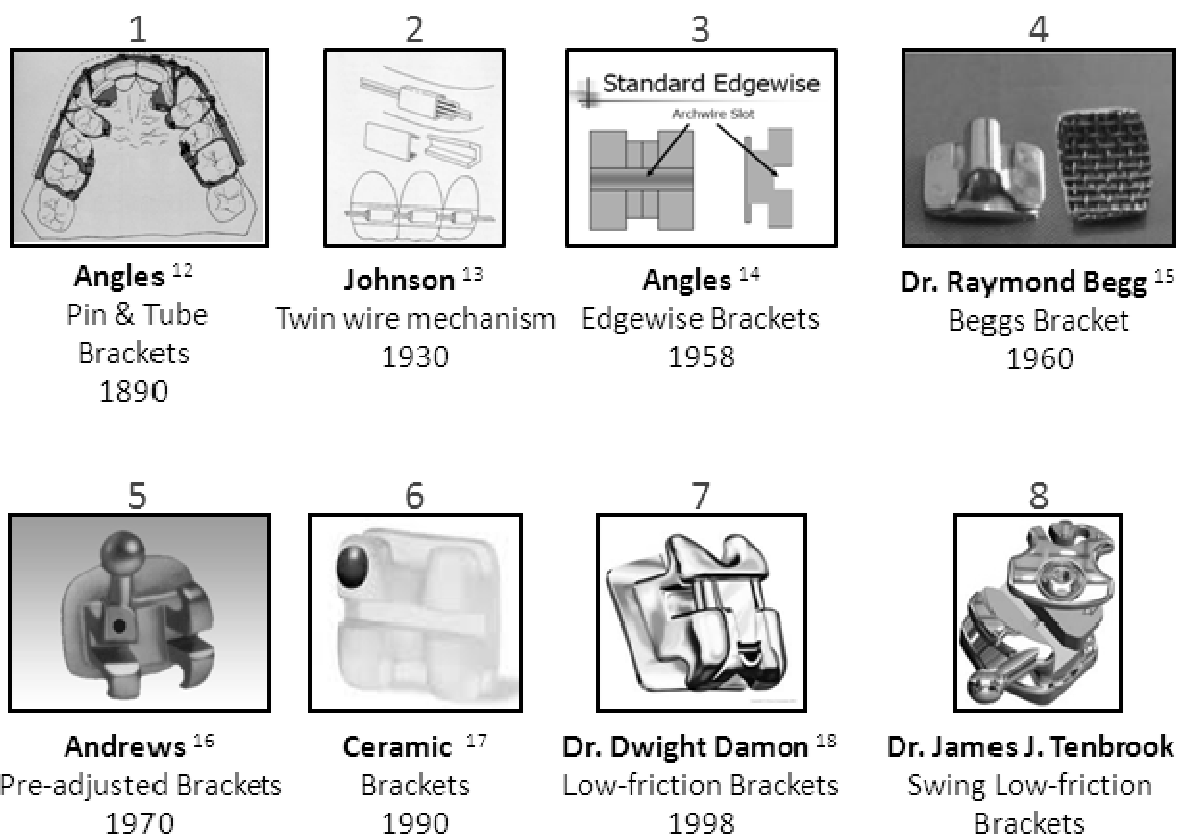


WIRE BENDING ROBOT-LAMDA

In order to over-come these dis-advantages it was decided by the authors to develop a orthodontic bracket which would move in 3 directions, thereby arranging the teeth in desired positions. These universally adjustable brackets could be set or adjusted by the operating doctor himself putting the control in his hands. It could be done in the clinic, chair-side so that no time to is wasted and the treatment plans could be changed mid-way through treatment. A mechanical model (ball & socket type) was developed.

2. DIFFERENT TYPES OF BRACKETS:

Fig. 6



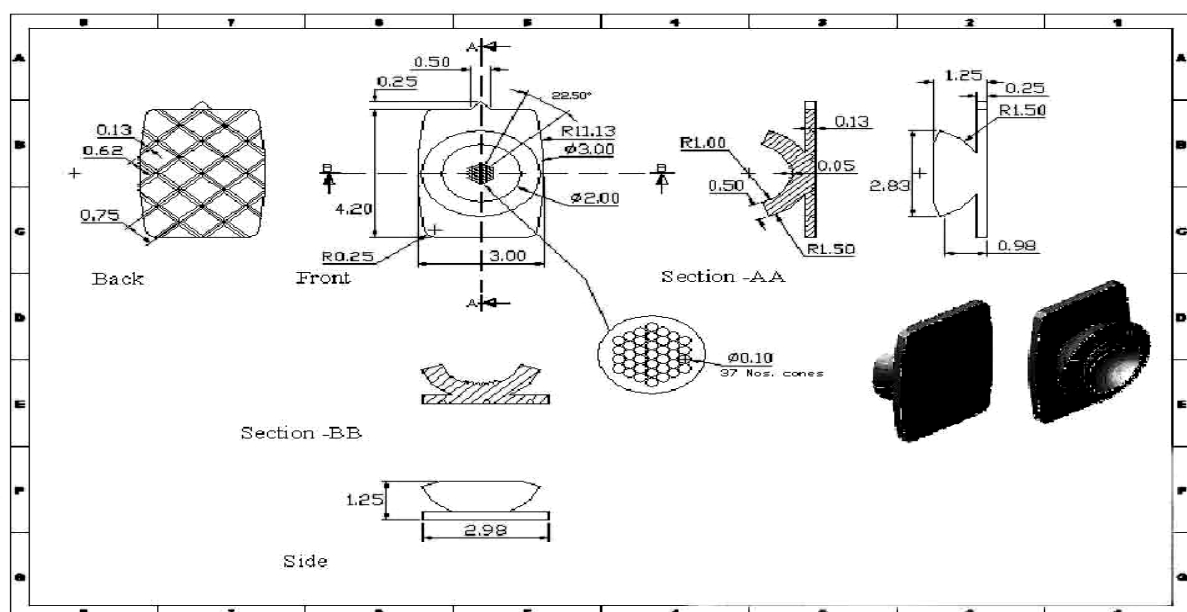
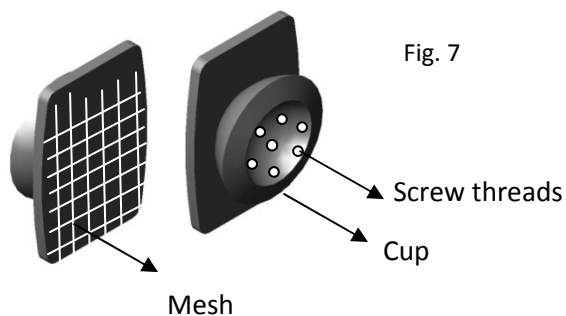


3. DESIGN:-

The bracket is to be made in 18.8 stainless steel. The dimensions are 1mm x 1.5 mm. It is made up of two parts (A) the base of the bracket & (B) the face of the bracket. Both parts are connected with a screw.

(A) The Base:-

The base consists of a mesh at the back which allows it to attach to the tooth surface with glue. In the front of the Base is a cup of 0.5mm radius. The cup is perforated with tiny screw threads arranged in concentric circles.



Drawings of a Mechanically Movable Bracket

(B) The Face:-

The face consists of the bracket wings & slot for the wire & a hole in the centre through which to thread a screw. The slot can be a traditional edgewise bracket slot as tip, torque & rotations can be adjusted with this bracket. The back of the face is has a cone shape which fits our cup of the base. The 'Cone Shape' fits snugly over the cup on the base & can move in all 3 planes of space x, y & z. with a 19.42° range of movement possible, which would cover most clinical requirements. The screw passing through the face of the bracket locks into any one of the many threads on the base.

This gives us multiple positions of the bracket slot & each position can be modified to suit the requirements of that particular tooth.

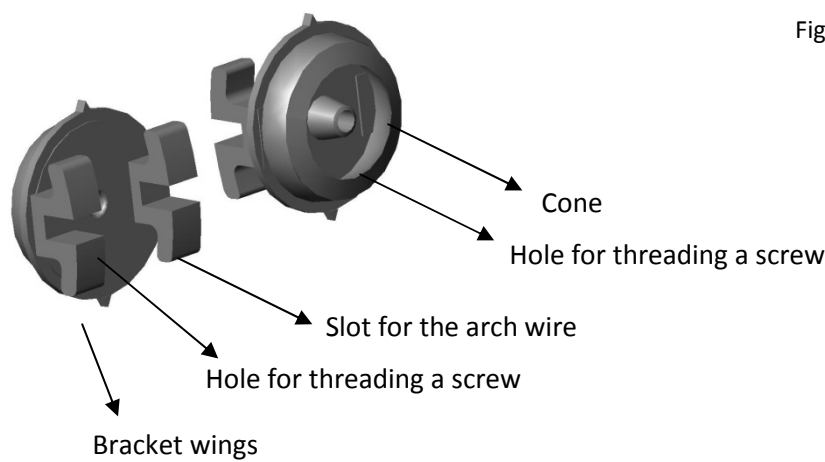
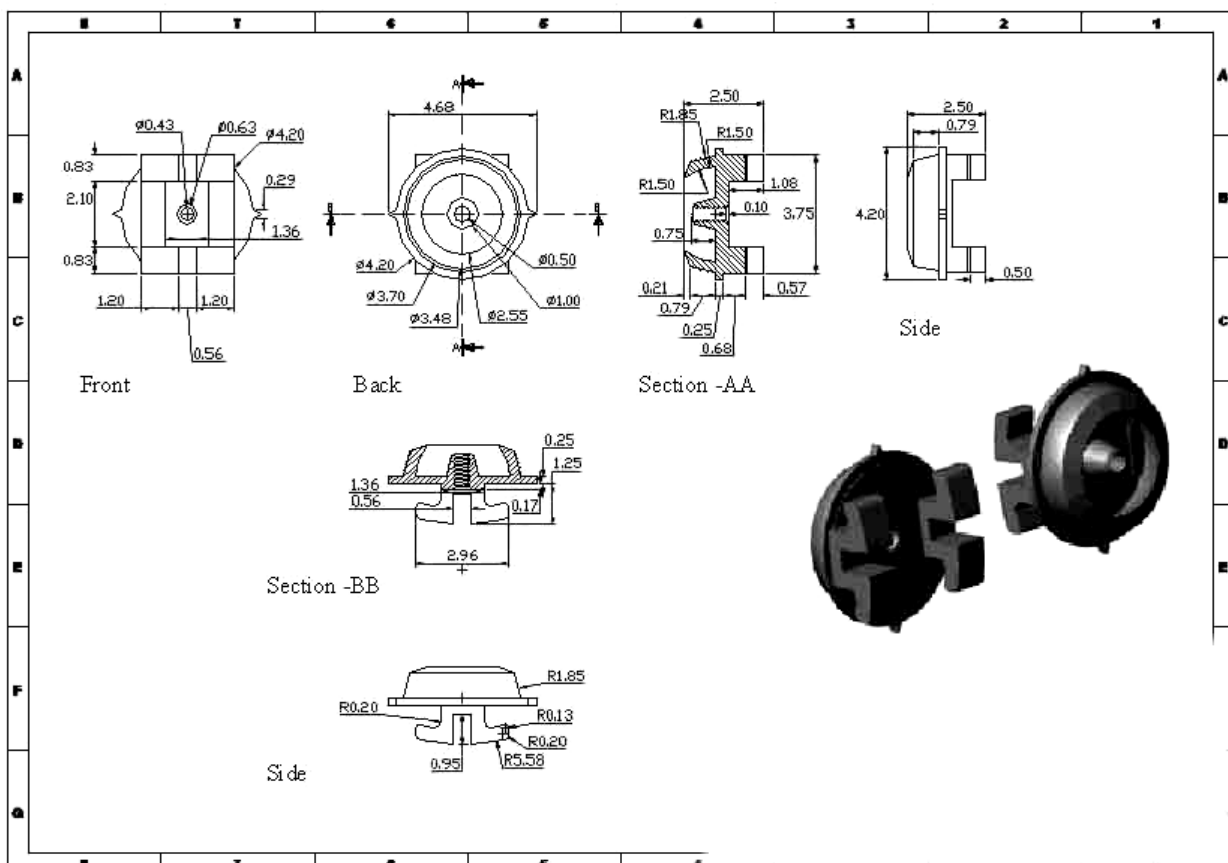
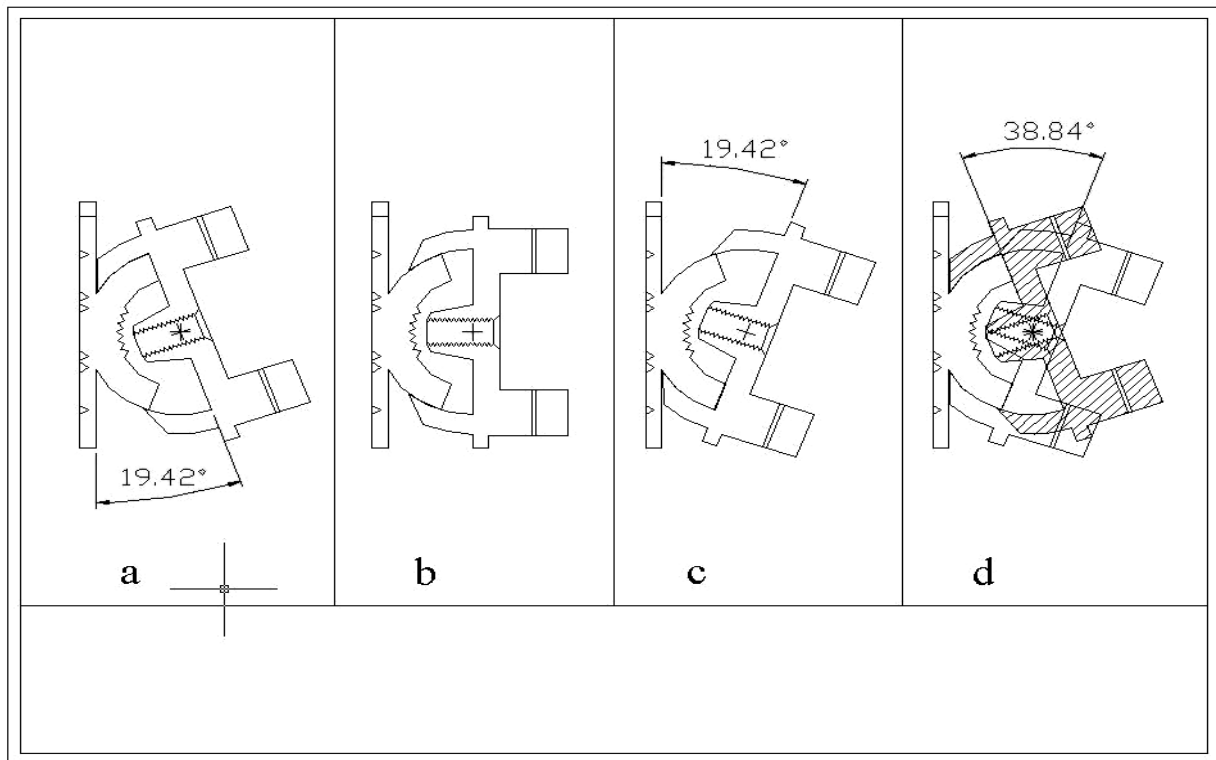


Fig. 8



(C) Side view of the bracket:-



4. ADVANTAGES OF A MECHANICALLY MOVABLE BRACKET AND UNIVERSALLY ADJUSTABLE BRACKET;

The new bracket is better than the old conventional brackets in the following ways:

- It is the age of customization. The traditional bracket concept of “one size fits all” is no longer feasible in today’s time. The new bracket is customized to precisely fit the needs of an individual patient’s requirements.
- It is very precise, right down to the factor of nanometers.
- Use of this bracket will completely eliminate wire bending. The bracket does all the work.
- Due to this, a minimum number of wires are needed to finish the treatment.
- The operator doesn’t need to be trained in orthodontics-a general dentist can perform the procedure as successfully as an orthodontist.
- It is inexpensive when compared to the equally precise robotic wires.
- This treatment is not dependent upon complex technology, so the treatment plan can be changed by the doctor midway.
- Extreme Precision & extremely low cost!

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AUTHORS

1. Dr. Alka Banker (MDS Orthodontia)
Diplomate of Indian Board of Orthodontics
Reader- Karnawati School of Dentistry
(Department of Orthodontics)



2. Dr. Akshai Aggarwal (Ph.D)
Vice Chancellor
Gujarat Technology University
AHMEDABAD, GUJARAT



3. Dr. Rupesh Vasani (Ph.D)
Faculty Dean Gujarat Technology University &
Principal Sal Institute of Technology

