



Review Article

Various bidimensional techniques used in orthodontics: A systematic review

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ABSTRACT

Maintaining torque with sliding mechanics in maxillary anterior teeth especially in presence of large extraction spaces has become a major concern among orthodontist. Loss of torque occurs owing to play between bracket system and arch wires. Thus, for torque control various arch wire twisting and torquing auxiliaries have been introduced. Not only do these techniques cause certain discomfort to patients but also extends patient chair time because of various chair side wire bending involved. Thus, a bidimensional technique in bracket system will be beneficial in controlling incisor torque simultaneously it will also assist in loss of anchorage in posterior teeth as it facilitates free sliding of arch wire through the bracket slot thus reducing friction. The aim of this article is to equip an overview of bidimensional technique in orthodontics.

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1. Introduction

In orthodontics clinically, torque represents the bucco-palatal crown or root inclination of teeth. When torque is applied over an orthodontic arch wire, it mainly expresses the activation generated by twisting an arch wire in a bracket slot.¹ Torque control is frequently required, specifically in the maxillary incisors, for a sufficient incisor contact, ideal interincisal angle and sagittal adaptation of the dentition in order to attain an ideal occlusion.² In presence of large extraction spaces during anterior retraction along with anchorage, loss of anterior torque requires instantaneous consideration. This mainly occurs due to play between bracket slot and orthodontic arch wires and thus specific prescribed torque of each bracket slot cannot be fully expressed which finally leads to less favourable results like inadequate incisal guidance or a flattened facial profile. To analyse torque expression in edgewise appliance including both conventional and self-

ligating brackets numerous studies have been conducted like optical image correlation technique, finite element method.^{3,4} Furthermore, several twisting of rectangular arch wire and numerous torquing auxiliaries have also been attempted. Besides, these techniques cause certain discomfort to a patient with no assurance of desired effects it also prolongs patient chair time because of various chair side wire bending involved. Hence for a better torque control, a “bidimensional” approach was put forward, so-called “bimetric system”⁵ by Schudy and Schudy⁵ in which, 0.016” inch slot brackets are applied on the anterior teeth (canine to canine), while 0.022”-inch brackets were used on the posterior teeth.

This Amalgamation was later put forward by Gianelly et al⁶ with their bidimensional technique. In its current form, 0.018” inch brackets are placed on maxillary and mandibular anteriors while 0.022”-inch bracket slots are placed on posterior teeth and incorporated into each setup. The two slot sizes represent a different set of distinct advantages to treatment mechanics.

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Differential slot size treatment mainly uses two different bracket slot sizes within the same appliance system and is the foundation of bidimensional treatment.

2. 22 mil bracket slot system

Numerous biomechanical advantages and disadvantages have been suggested for 0.022" slot. It has been postulated that 0.022" slot offers more options in arch wire size selection.^{7,8} A 22mil slot system provides less binding at the bracket wings or frictional resistance. Using undersized arch wires one can expedite the free sliding of the arch wire through the bracket slot. It's been proposed that overbite reduction and residual extraction space closure could be more efficacious with 0.022" bracket slots as the space between the working arch wire i.e., (0.019" X 0.025" SS) and 0.022" slot permits bite-opening bends to be placed while still being able to be fitted with relative ease.⁹

Other advantage of a 22mil slot system is that it allows considerable tipping as it permits substantial play between arch wire and bracket slot while using undersized wires like 0.016" which could be favourable. It also accepts very rigid wires when an arch expansion is required or maintaining arch form while moving impacted canines, also for special case fixation in surgery. Gentle transitions could be observed as a 0.022" slot enable use of a series of arch wire sizes gradually increasing in precision of a fit, this could be specifically expedient with bracket systems having a built in first, second and third order control.

Using a larger diameter wire has its own merits and demerits like it enhances the stiffness and helps to keep teeth straight when large extraction spaces are present in retraction mechanics though a downside may be accosted while filling the bracket slot as full-size SS rectangular wire lacks springiness and range, thus limiting its potential for finishing bends and effective torque.

3. 18 mil bracket slot system

Introduction of stainless-steel alloy facilitated the use of smaller dimension wires as it has similar rigidity and stiffness as that of a much larger gold alloy wire that led to introduction of much smaller 0.018" slot in orthodontics, although the commencement of 0.018" slot did not oust using 0.022" bracket slots from clinical practice.¹⁰

A smaller 0.018" slot system has its own sets of pros and cons, despite having fewer choices in arch wire dimensions is available, filling a bracket slot can be more easily attained. This mainly allows a greater use of the prescription/program built with in a bracket slot. Thus, a key benefit of an 18-mil slot system is filling the slot early in a treatment with a built-in bracket prescription that helps to maintain anterior torque. During retraction phase in an extraction treatment for an ideal position of anterior teeth, torque control is crucial. An unwanted lingual crown torque or a labial root torque can

tend to lingualize anterior teeth during course of retraction. An under torquing of anterior may cause certain difficulties especially during finishing stages and can prolong course of treatment even further. Hence in an 0.018" system, early filling a bracket slot will preserve the position of anterior teeth more effectively.

Distinct advantage of a 0.018" bracket slot system is the working arch wire for an 18-mil slot i.e., 0.016" X 0.022" that would deliver third order movement more efficiently without requirement of any additional wire bending.⁹ Drawback of a 0.018" bracket system involves lesser play even with lighter wires. It also doesn't provide much freedom for tipping nor this system accepts very rigid wires when required as in many instances an insufficient play between an 18-mil bracket system and wire is present in applications when much heavier wires are needed. Though numerous studies showed when comparing 0.018" slot with an 0.022" slot treatment time of an orthodontic treatment is shorter along with better outcomes.^{11–13}

4. Various bidimensional techniques/system

4.1. Bimetric system

The bimetric system was described by Dr Fred F. Schudy and Dr. George F. Schudy in mid 1970s. This precise technique took edge of the advantage of lighter wires while keeping the merit of much heavier wires. In this mainly two different bracket slot sizes were used in same mouth. A standard edgewise with zero base¹⁴ of 0.016" slot were used in upper and lower incisors as well as in canines while a 0.022" slot were used in both upper and lower bicuspid and first molar (except when the first molars are in non-restorable status i.e. terminal teeth), (Figure 1).

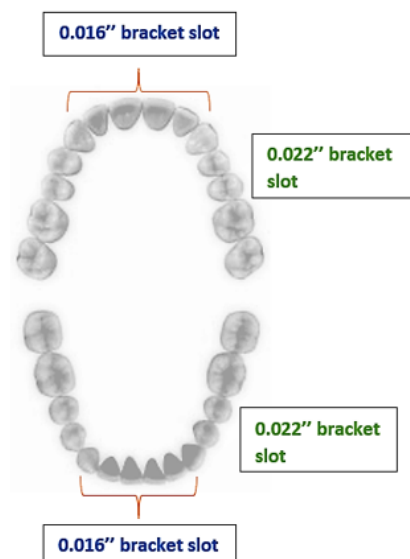


Fig. 1: Bimetric System

Slot (anterior)	Slot (posterior)	Arch wire (anterior)	Arch wire (posterior)
0.016 inch	0.022 inch	0.016" X 0.022"	0.022" X 0.016"

Summary (Bimetric System)

A 0.016"x 0.022" stainless steel wire was used which was twisted and torqued 90° distal to canines and the aim was that the wire should completely fill all the brackets slot of two different sizes with same wire. Thus, in anterior the treatment wire was an edgewise wire while a ribbon arch wire of dimension 0.022"x 0.016" was created for posterior segment. Schudy and Schudy termed this as a precision-fit principle in which in later finishing stages, wire should completely fill a bracket and there should be no or minimal play between arch wire and bracket slot, such precise relationship between bracket slot and wire provides complete control over tooth thus this system eliminates use of artistic bends and frequent removal of arches for individual torque control hence reduces the amount of effort required to complete an orthodontic treatment.

4.2. Bidimensional system

Following bimetric technique described by Schudy and Schudy, Gianelly¹⁵ presented a preadjusted edge-wise bidimensional system which he termed as bidimensional technique¹⁵ in which he used vertical slot or V-slot brackets of dimension 0.018" for central and lateral incisors and 0.022" slot for canines, bicuspids, and molars.

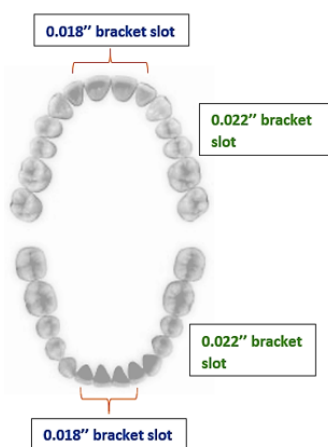


Fig. 2: Bidimensional Technique

Slot (anterior)	Slot (posterior)	Arch wire (anterior)	Arch wire (posterior)
0.018 inch (incisors) / 0.022 inch (canine)	0.022 inch	0.018" X 0.022"	0.018" X 0.022"

Summary (Bidimensional Technique)

Same working principle was used in which for incisors smaller brackets of slot size 0.018" X 0.025" were applied for a better tight fit and three-dimensional control and much larger bracket slot size i.e., 0.022" X 0.028" were applied on posterior teeth, thus providing a loose fit to leverage sliding mechanics (Figure 2).

Stainless steel arch wire having dimension 0.018" x 0.022" was engaged that completely fits into the anterior brackets, but leaves a clearance of 0.004" within the buccal brackets, thus facilitating easy insertion of wire especially in buccal segments. Gianelly indicated that during retraction of maxillary incisors torque control is necessary.

Gianelly made a salient point that for space closure stainless steel wires of dimension 0.017" X 0.025" or 0.018" X 0.025" are not a feasible alternative for 0.016" X 0.022" or 0.018" X 0.022" stainless steel wires as for space closure too much resistance could be created from wire horizontal dimension of 0.025". Thus, working arch wires used were 0.016" X 0.022" stainless steel or 0.018" X 0.022" stainless steel with crimpable hooks attached distal to the lateral incisor brackets and closed Ni-Ti coils attached to molar hooks and crimp-on. For torque control in canines, arch wire was twisted and torqued 90° to both mesial and distal aspects of canine bracket thus a ribbon arch wire of dimension 0.022" X 0.018" is created in canine bracket and full engagement is obtained. Nevertheless, main concern regarding proposed system was lack of three-dimensional control and presence of play between arch wire and brackets slots in buccal segments for which Gianelly like Schudy and Schudy gave same justification in which stainless steel arch wire of dimension 0.018" X 0.022" should be twisted 90° distal to laterals thus filling the slots of posterior brackets and thus a 0.022" X 0.018" stainless steel ribbon arch wire was created for buccal segment.

Earlier Gianelly introduced another modification which he termed as bidimensional edgewise technique¹⁶ in which, non-preadjusted brackets having slot size of 0.022" X 0.028" were used on all teeth (Figure 3). Like Schudy and Schudy, stainless steel arch wire having dimension 0.016" X 0.022" was used which was torqued and twisted 90° distal to brackets of lateral incisors thus a ribbon arch wire of dimension 0.022" X 0.016" was created in anterior at the same time the working arch wire in buccal segment was an edgewise wire having dimension 0.016" X 0.022" this mainly provided a tight fit and minimal play in anterior brackets and a loose fit in buccal brackets with a clearance of 0.006" that mainly facilitates sliding mechanics for space closure. Though lack of three-dimensional control and presence of play between arch wire and bracket slot in posterior segments and involvement of unconventional 90° twisting of arch wire was the reason less cases were reported using Gianelly proposed bidimensional methods.^{17–20}

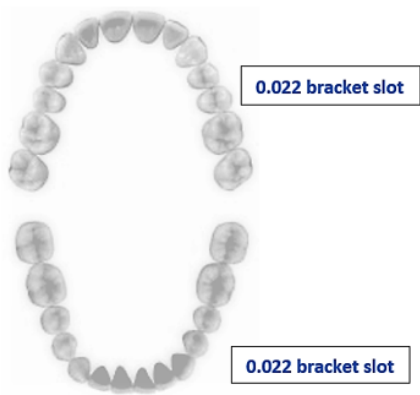


Fig. 3: Bidimensional edgewise technique

Slot (anterior)	Slot (posterior)	Arch wire (anterior)	Arch wire (posterior)
0.022 inch	0.022 inch	0.022" X 0.016"	0.016" X 0.022"

Summary (Bidimensional edgewise technique)

4.3. Dual slot system

Working with bi dimensional system for several years, Dr Daniel J. Rinchuse and Dr Donald J. Rinchuse made certain modifications and advancement with Gianelly proposed system and developed a “Dual slot system”.²¹ It mainly constitutes of 18mil bracket slot for anterior teeth while much larger brackets with slot size 22 mil were used in posterior teeth (Figure 4) and a single arch wire of dimension 0.018”X 0.025” was used for retraction. Using an 0.018” X 0.025” stainless steel wire would completely fill anterior bracket i.e. (0.018” slot), thus there would be no to very minimal play between arch wire and bracket slot which mainly provides a better three-dimensional control for anterior teeth. Proffit²² stated that a minimum clearance of 0.002 inch to 0.004 inch between a bracket slot and an arch wire is necessary to facilitate sliding mechanics. Thus, using a 0.018” X 0.025” stainless steel wire with much larger 22 mil slot brackets provides a clearance of 0.004 inch which will reduce resistance and will aid in retraction. Also, Stainless steel arch wire of dimension 0.018 inch in a 18 mil slot when compared to same 0.016 inch wire in 16 mil slot is much more stiffer and will have lesser affinity towards notching and deformation.

Rinchuse and Rinchuse proposed “dual slot system” used an en-masse retraction for space closure rather than two step retraction which was followed by Gianelly. Xu TM et al,²³ in their randomized clinical trial when comparing two-step retraction with en-masse retraction concluded that two step retraction lengthens time duration of an orthodontic treatment also it’s not more efficacious in avoiding clinically meaningful anchorage loss. Unlike Gianelly, rationalization given for posterior torque control was that a conventional

torque in arch wire could be placed rather than twisting a rectangular stainless steel arch wire to 90° mainly distal to lateral incisors to form a ribbon arch. Marshall et al²⁴ in his study indicated that patient of age group between 7.5 years to 26.4 years with normal transverse growth of mandible and maxillary molars, mandibular first and second molars tend to upright buccally i.e., by 5° and 7.5°. Also, maxillary first and second molars on average tend to upright lingually by 3.3° and 5.9° respectively. Mandibular first and second intermolar width increased by 2.2 mm and 0.78 mm and maxillary first and second intermolar width increased by 2.8 mm and 2.0 mm, thus a prescribed bracket torque in buccal segments could eventually be altered by growth. Also, for most of orthodontist working with a 22-mil bracket slot system ultimately finish their cases with a 0.019” X 0.025” stainless steel arch wire²⁵ thus a play between an arch and bracket slot could be observed, considering that a dual slot system has only play in posterior segments and provides a tight fit and three-dimensional control in anterior brackets. Another difference is that a dual slot system uses a round Nickel titanium as an initial wire while in a bidimensional technique rectangular wire is used thus it also prevents from various harmful effects on roots caused by rectangular wire.²⁶

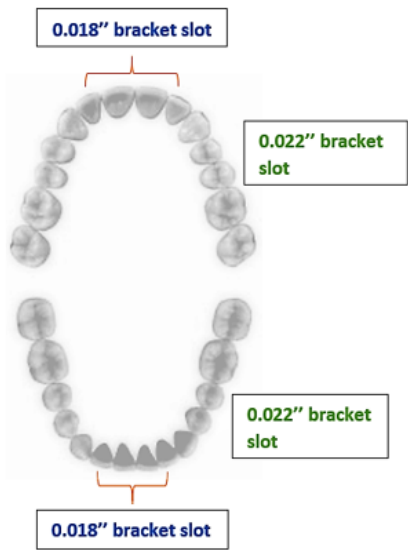


Fig. 4: Dual Slot System

Slot (Anterior)	Slot (Posterior)	Arch wire (Anterior)	Arch wire (Posterior)
0.018 inch	0.022 inch	0.018" X 0.025"	0.018" X 0.025"

Summary (Dual Slot System)

4.4. Modern Trends

Rinchuse and Miles²⁷ illustrated a '**Hybrid self-ligating bracket system**' that constitute either entirely an 18 mil or 22 mil self-ligating bracket slot with an active spring clip on anterior brackets and passive slide on buccal brackets. Though an active self-ligating bracket are generally much smaller than conventional brackets size i.e., 0.018" X 0.025" or 0.022" X 0.028" as an oblique active spring clip compromises gingival horizontal wall thus a rectangular wire of dimension 0.019" X 0.025" in a 22 mil self-ligating bracket will provide a tighter fit and better three-dimensional control on anterior active self-ligating brackets. Also, at same time possibly it will facilitate free sliding by reducing friction in posterior passive brackets.^{28–30}

Another modification developed was a '**Dual slot hybrid self-ligating bracket system**', it consists of different brackets slot size i.e., an 18mil slot and an 22mil slot with different brackets i.e., active and passive with in same mouth. 0.018" active self-ligating brackets were used in anterior teeth and much larger 0.022" passive brackets were used in posterior teeth with 0.018" X 0.025" or 0.017" X 0.025" stainless steel as finishing wires. In comparison with passive self-ligating, active self-ligating bracket provides better torque expression,³¹ however, passive self-ligating brackets will help to lower friction and will aid in sliding. Yet another modulation described was a '**Dual slot self-ligating system**' or dual slot active self-ligating and dual slot passive self-ligating bracket system consisting either active or passive self-ligating brackets with 18 mil brackets on anterior teeth and a 22-mil bracket slot on posterior teeth.

4.5. Advantages of various bidimensional techniques

1. Key benefit of bidimensional technique is that it maintains incisor torque as a slot with bracket prescription is filled early in an orthodontic treatment.
2. Sufficient clearance of 0.004" in buccal segment between bracket slot (0.022") with much smaller 0.018 X 0.025" arch wire, facilitates free sliding while space closure. Also reduced friction in posterior teeth brackets conserve anchorage.
3. En-masse retraction in a dual slot system decrease treatment time.²³ Also, a free sliding in buccal brackets is provided during anterior retraction and posterior protraction at the same time sustaining anterior torque control.
4. The amount of root resorption in a bidimensional technique is identical to that of straight wire.³²
5. At the end of a treatment, an arch form was well maintained. Also, there was no additional requirement for torquing auxiliaries which makes bidimensional technique relevant.

5. Conclusion

Besides bidimensional technique being both beneficent and effective as well as simple fewer orthodontist reported practicing these methods in their regular practices.³³ Bidimensional techniques provide two distinct advantages at same time i.e., better anterior torque control along with free sliding in posterior brackets thus further studies involving randomised clinical trials as well as more systematic reviews are required.

6. Source of Funding

None.

7. Conflict of Interest

None.

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