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Review Article

0.018" VERSUS 0.022" BRACKET SLOT SYSTEMS IN ORTHODONTICS: A REVIEW

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ABSTRACT

The on-going appliance evolution in Orthodontics has resulted in two orthodontic bracket slot sizes which a clinician can choose to use when correcting patient's malocclusion today. The 0.022-inch slot was the first to be introduced by Edward Angle in the late 1920s which suited the gold wires. As steel arch wires were stiffer, the ''light-wire'' technique set the trend at 0.018 from 0.022 inches. In edgewise appliance also, a reduction in slot size from 22 to 18 mil was advocated for the same purpose. Good torque is possible with steel wires and 18mil edgewise brackets and it may be a way to reduce friction if teeth are to slide along the arch wire. A disadvantage of the 0.018-inch slot is that in many instances there is insufficient play between the wire and the bracket. The 22-slot bracket has some advantage during space closure as it provides optimal clearance for sliding but it is a disadvantage when torque is needed later. There has long been a debate about the reason for the existence of two bracket slot dimension systems in literature. Therefore the focus of this review is on the comparative analysis of effectiveness of .018-inch and 0.022-inch bracket slots.

Keywords: 0.018-Inch Slot; 0.022-Inch Slot, Brackets, Slot Size.

INTRODUCTION

The on-going appliance evolution in Orthodontics has resulted in two orthodontic bracket slot sizes which a clinician can choose to use when correcting patient's malocclusion today. The 0.022-inch slot was the first to be introduced by Edward Angle in the late 1920s and this suited the gold wires. When steel arch wires replaced gold, Angle's original engineering calculations were no longer valid because steel wire of the same size was stiffer.[1] As a result ''light-wire'' technique used a ribbon arch 0.020-inch bracket slot with 0.016-inch stainless steel archwires and this downward trend in slot dimensions was settled at 0.018 from 0.022 inches.

In the edgewise appliance also, a reduction in slot size from 22 to 18 mil was advocated for the same purpose. Good torque was possible with steel wires and 18mil edgewise brackets. On the other hand, using undersized arch wires in edgewise brackets was a way to reduce friction if teeth were to slide along the arch wire. But, practically, sliding teeth along an arch wire requires at least 2 mil of clearance and even more clearance may be desirable.[1] The original 22-slot bracket therefore would have some advantage during space closure but would be a definite disadvantage when torque was needed later. Any ''play'' or ''slop'' between these components will result in incomplete transmission of the bracket prescription to the tooth and its supporting tissues. A disadvantage of the 0.018-inch slot is that in many instances there is insufficient play between the wire and the bracket[1].

Thus, these two dimensions 0.018-inch and 0.022-inch bracket slot systems are widely used by clinicians worldwide with some orthodontists claiming clinical advantages and superiority of one system over the other. There has long been a debate about the reason for the existence of two bracket slot dimension systems; with several orthodontists calling for standardization. Therefore the focus of this review is on the comparative analysis of effectiveness of .018-inch and 0.022-inch bracket slots.

EFFECT OF BRACKET SLOT SIZES IN LEVELING STAGE[1]

Leveling by extrusion can be done with continuous archwires by placing an exaggerated curve of Spee in the maxillary archwire and a reverse curve of Spee in the mandibular archwire. The choice of wires for this purpose is affected by the slot sizes of the edgewise appliance being used.

1) 18-Slot, Narrow Brackets[1]:

After preliminary alignment, the second archwire is usually a 16mil steel wire with an exaggerated curve of Spee in the upper arch and a reverse curve in the lower arch or a preformed 16 mil A-NiTi wire to complete the leveling. In some patients, particularly in non-extraction treatment of older patients who have little if any remaining growth, an archwire heavier than l6mil steel is needed to complete the leveling of the arches. But, rather than using an 18mil archwire, Proffit recommends to add an auxiliary leveling arch of 17 x 25mil TMA or steel. This arch inserts into the auxiliary tube on the molar and is tied anteriorly beneath the l6 mil base arch. Leveling occurs almost totally by extrusion.

2) 22-Slot, Wider Brackets[1]:

Initial alignment with a 17.5mil twist or 16mil A-NiTi wire is usually followed by a 16mil steel wire with a reverse or accentuated curve and then by an 18 mil round wire to complete the levelling and it is rare that 20mil wire or an auxiliary archwire is required.

CONTEMPORARY MECHANOTHERAPY FOR SPACE CLOSURE WITH THE 18- AND 22 SLOT EDGEWISE APPLIANCE[1]

1) Moderate Anchorage Situations[1]:

The different wire sizes in 18- and 22-slot edgewise appliances require a different approach to mechanotherapy.

A) With 18-Slot Edgewise: Closing Loops[1]:

Although either sliding or loop mechanics can be used, the 18-slot appliance with single or narrow twin brackets on canines and premolars is ideally suited for use of closing loops in continuous archwire. Closing loop archwires should be fabricated from rectangular wire to prevent the wire from rolling in the bracket slots. An excellent closing loop for 18-slot edgewise is a delta-shaped loop in 0.016” x 0.022” wire that is activated by opening. It fits tightly in an 0.018” x 0.025” bracket to give good control of root position. With 10mm of wire in the loop, the force delivery is close to the optimum, and the mechanism fails safe because contact of the vertical legs when the loop is deactivated limits movement between adjustments and makes the archwire more rigid.

B) Moderate Anchorage Space Closure With 22-Slot Edgewise[1]:

As a general rule, space closure in moderate anchorage situations with the 22-slot edgewise appliance is done in two steps: This two-step space closure will produce an approximately 60:40 closure of the extraction space. A 0.019” x 0.025” wire is the largest on which sliding retraction of a canine should be attempted (because clearance in the bracket slot is needed), and 0.018” x 0.025” wire also can be used. The canine retraction can then be carried out with a coil spring, a spring soldered to the base archwire, an intra-arch latex elastic or an elastomeric material.

The second stage in the two-stage retraction is completed with a closing loop, although it is possible to close the space mesial to the canines by again sliding the archwire through the posterior brackets. An 0.018” x 0.025” steel wire with a T-loop, though too stiff, serves this purpose reasonably well while retaining the fail-safe design. A third alternative, is a closing loop in 0.019” x 0.025” beta-Ti wire which provides better properties than 0.018” x 0.025” steel.

2) Maximum Retraction[1]:

A) With the 18-Slot appliance[1]:

With the 18-slot appliance, friction from sliding usually is avoided by employing closing loops. To obtain greater retraction of the anterior teeth and to reduce anchorages strain:

1. Add stabilizing lingual arches and start with en masse space closure.
2. Reinforce maxillary posterior anchorage with extraoral force and use Class III elastics from high-pull headgear to supplement retraction force in the lower arch.
3. Retract the canines independently using a segmental closing loop, and then retract the incisors with a second closing loop archwire. Segmented retraction of the canines with frictionless springs is an attractive method for reducing the strain on posterior anchorage and is a readily available approach with the modern 18-slot appliance. It is also possible to retract the canines by sliding them on the archwire, but the narrow brackets usually used with the 18-slot appliance and the tight clearance and relatively low strength of a 0.017” x 0.025” archwire produce less-than-optimum sliding. Canine retraction can also be done by Paul Gjessing’s spring. It is an efficient method but the spring is complex to fabricate and activate.

After canine retraction, closing loops are used for en-masse incisor retraction either with continuous arch or with segmented arch.

B) Maximum retraction with 22 slot appliance[1]:

The same basic approaches are available with the 22- as with the 18-slot appliance: to increase the amount of incisor retraction, a combination of increased reinforcement of posterior anchorage and decreased strain on that anchorage is needed. All the possible strategies for anchorage control can be used. With a 22-slot appliance, sliding along a 0.019” x 0.025” steel archwire with A-NiTi coil spring is the usual approach. Skeletal anchorage greatly simplifies retraction and it is possible to close the extraction space with en-masse movement of anterior teeth rather than separate canine retraction. The use of a segmented arch system to retract the canines independently, followed by retraction of the four incisors, is a practical method for conserving anchorage and equally adaptable to 22- and 18-slot appliance.

FINISHING STAGE WITH 18 AND 22 SLOTS[1]

With a modern edgewise appliance, only moderate additional torque should be necessary during the finishing stage. With the 18-slot appliance, a 0.017” x0.025” steel archwire has excellent properties of torsion and torque. Prior to brackets with built-in torque and titanium archwires, torquing auxiliaries were commonly used with the 22-slot appliance.

In addition, full-dimension M -NiTi or beta-Ti archwires can be used to torque incisors with 22-slot brackets. With the 22-slot appliance, some prescriptions have extra built-in torque to compensate for rectangular finishing archwires that will have more clearance. Torque will not be expressed to the same extent with a 0.019” x 0.025” wire in a 22-slot bracket as with a 0.017” x0.025” wire in an 18-slot bracket. For full expression of the torque built into brackets in the 22-slot appliance, the best finishing wire usually is 0.021” x 0.025” beta-Ti. Braided rectangular steel wires of 0.021” x 0.025” dimension also can be useful in 22-slot finishing. A solid 0.021" x 0.025" steel wire cannot be recommended because of its stiffness and the resulting extremely high forces and short range of action. If a solid steel wire of this size is used (the major reason would be surgical stabilization), it should be preceded by 0.021" x 0.025" beta-Ti.

MBT TECHNIQUE: THE 0.022" V/S 0.018" SLOT[2]

According to Mc Laughlin, Bennett and Trevisi:

The preadjusted system works best with 0.022" slot because…..

The larger slot allows more freedom of movement for the starting arch wire.

Also later in the treatment, 0.019" x 0.025" steel arch wire performs better during space closure with sliding mechanics as they are stiffer than 0.017" x 0.025" steel wire (used in 0.018" slot) which are more flexible and hence show greater deflection and binding during space closure.

VARIOUS STUDIES

The 0.018-inch and 0.022-inch bracket systems have been compared regarding: Treatment duration, Treatment outcome, Torque efficiency of stainless steel and NiTi archwires and Treatment duration.

By **Amditis and Smith**,[3] the duration of fixed appliance Edgewise orthodontic treatment using brackets with 0.018" and 0.022" slots was measured to determine significant differences between the two appliances. The mean difference in duration of treatment (1.5 months) was not found to be clinically significant.

Nucera et al[4] evaluated effects of different bracket-slot design characteristics on the forces released by superelastic NiTi alignment wires at different amounts of wire deflection. They concluded that bracket slot significantly affects the amount of force released by superelastic NiTi alignment wires. The use of a 0.018-inch slot bracket system, compared with a 0.022-inch system, increases the force exerted by the superelastic NiTi wires after 2 mm of maximum deflection. After 4 mm of maximum wire deflection, the vertical slot dimension does not affect the forces released by superelastic NiTi wires.

Detterline et al[5] quantitatively compared the clinical outcomes of orthodontic cases treated in a university graduate orthodontic clinic using the American Board of Orthodontics (ABO) Objective Grading System (OGS) in cases treated with 0.018-inch brackets Vs 0.022-inch brackets. There were statistically, but not clinically, significant differences in mean treatment time (3.9 months) and in total ABO-OGS score (2.7) in favour of 0.018-inch brackets as compared with 0.022-inch brackets.

Ahmed M F El-Angbawi,[6] compared 0.018-inch and 0.022-inch conventional pre-adjusted orthodontic bracket slot systems in terms of the effectiveness during leveling and alignment stage of orthodontic treatment. No statistically significant difference in the severity of OIIRR and patient perception of wearing orthodontic appliances between the two study groups except for the soreness of teeth, where more patients in the 0.022-inch group experienced significant teeth soreness. Thus, no difference was found in the effectiveness of the leveling and alignment stage of orthodontic treatment between the 0.018-inch or 0.022-inch conventional bracket slot systems except for the soreness of teeth.

Hirai et al[7] measured the torque moment that can be delivered by various archwire and bracket combinations at the targeted tooth. Stainless steel (SS) upper brackets with 0.018 and 0.022 inch slots, two sizes of nickel–titanium (Ni-Ti) alloy wires, and three sizes of SS wires for each bracket were used. The wire was ligated with elastics or wire. The results of their study showed that torque moment was increased with larger degrees of torque and wire sizes. There was no significant difference in torque moment between the SS and Ni-Ti wires at lower degrees of torque and at torque higher than 40 degrees. The torque moment with wire ligation was significantly larger than with elastic ligation for the 0.016" × 0.022" and 0.017" × 0.025" Ni-Ti wires in the 0.018 inch slot brackets and the 0.017" × 0.025" and 0.019" × 0.025" SS and Ni-Ti wires in the 0.022 inch slot brackets.

Sifakakis et al[8] **(2012)** assessed the effect of the moments generated with low- and high torque brackets. It was found that high-torque brackets produced higher moments compared with low-torque brackets. Additionally, in both high- and low-torque configurations, the thicker 0.019 × 0.025 inch steel archwire in the 0.022 inch slot system generated lower moments in comparison with the 0.017 × 0.025 inch steel archwire in the 0.018 inch slot system.

Sifakakis et al[9] **(2013)** compared the archwires inserted during the final stages of the orthodontic treatment with the generated moments at 0.018- and 0.022-inch brackets. The 0.017 x 0.025-inch stainless steel and β-Ti archwires in the 0.018-inch slot generated higher moments than the 0.019 x 0.025-inch archwires because of lower torque play. This difference is exaggerated in steel archwires, in comparison with the β -Ti, because of differences in stiffness. The differences of maximum moments between the archwires of the same cross-section but different alloys were statistically significant at both slot dimensions.

Archambaulta et al[10] reviewed the quantitative effects on torque expression of varying the slot size of stainless steel orthodontic brackets and the dimension of stainless steel wires. He concluded that clinically effective torque can be achieved in a 0.022 inch bracket slot with archwire torsion of 15 to 31 degrees for active self-ligating brackets and of 23 to 35 degrees for passive self-ligating brackets with a 0.019 0.025 inch stainless steel wire.

Eric Ray Nease[11] compared 0.018 inch and 0.022 inch slot orthodontic brackets to determine differences in treatment outcome between the two. There was no statistically significant difference in the number of different arch wires used by each slot size. 0.018 inch slot cases required significantly fewer arch wire changes than 0.022 inch slot cases. Cases treated with the 0.022 inch slot experienced a significantly greater number of bond failures. Neither appliance exhibited superior bite-opening ability or overjet correction. In addition, arch width was controlled equally well with each appliance. Cases treated with 0.018 inch slot brackets also achieved significantly lower values for post-treatment incisor irregularity than 0.022 inch slot cases.

Thus it is well understood after reviewing the literature that the advantages of 0.018" slot are; decreased wire inventory, shorter treatment time (according to some studies) and increased wire flexibility due to smaller dimension of wires while the disadvantages of 0.018" slot are; desired third order moment to force ratios may not be produced by newer orthodontic alloys and less than optimum sliding.

In the same way the advantages of 0.022" slot are that newer orthodontic alloys can be used with minimum patient discomfort and optimum clearance for sliding is obtained while the disadvantages of 0.022" slot are that increased wire inventory is required and there lies an inability to attain third order control till last stages of treatment.

CONCLUSION

Though both the 0.018 and 0.022 slot may still be used based on personal preferences, a uniform slot size and tooling units may be necessary for standardization and to know that we really use the slot size we want irrespective of where the manufacturer is based.

REFERENCES

1. Proffit WR. Contemporary Orthodontics. Mosby Elsevier. 5th Edition 2013. Pages: 548-589.
2. Mc Laughlin, Benett, Trevisi. Systemized Orthodontics Treatment Mechanics. Mosby International Ltd. 2001. Page no. 14.
3. Amditis C, Smith LF. The duration of fixed orthodontic treatment: a comparison of two groups of patients treated using edgewise brackets with 0.018" and 0.022" slots. Aust Orthod J. 2000; 16(1): 34-39.
4. Nucera R, Gattob E, Borsellinoc C, Aceto P, Fabiano F, Matarese G, Perillo L, Cordasco G. Influence of bracket-slot design on the forces released by superelastic nickel-titanium alignment wires in different deflection configurations. Angle Orthod. 2014; 84: 541–547.
5. Detterline DA, Isikbay SC, Brizendine EJ, Kula KS. Clinical Outcomes of 0.018-Inch and 0.022-Inch Bracket Slot Using the ABO Objective Grading System. Angle Orthod. 2010; 80: 528–532.
6. El-Angbawi AMF: Is the 0.018-inch or the 0.022-inch bracket slot system more effective for the leveling and alignment stage of orthodontic treatment? Thesis submitted for the degree of Doctor of Philosophy to the College of Medicine, Dentistry and Nursing Section of Orthodontics Dundee Dental Hospital and School University of Dundee.
7. Hirai M, Nakajima A, Kawai N, Tanaka E, Igarashi Y, Sakaguchi M, Sameshima GT, Shimizu N. Measurements of the torque moment in various archwire–bracket–ligation combinations. European Journal of Orthodontics. 2012; 34:374–380.
8. Sifakakisa I, Pandis N, Makou M, Eliades T, Katsaros C, Bourauel C. Torque expression of 0.018 and 0.022 inch conventional brackets. European Journal of Orthodontics. 2012;41: 1-5.
9. Sifakakisa I, Pandis N, Makou M, Eliades T, Katsaros C, Bourauel C. Torque efficiency of different archwires in 0.018- and 0.022-inch conventional brackets. Angle Orthod. 2014; 84(1):149-154.
10. Archambaulta A, Lacoursiere R, Badawi H, Major PW, Carey J, Flores-Mir C. Torque Expression in Stainless Steel Orthodontic Brackets: A Systematic Review. Angle Orthod. 2010; 80: 201–210.
11. Nease ER. 0.018" versus 0.022" slot orthodontic brackets: A comparative analysis. Am J Orthod and Dentofacial Orthop. 2000; 117(2):A1.

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