



ASSESSMENT OF THE EFFICACY OF DUPLOSLOT BRACKETS IN FIXED ORTHODONTIC TREATMENT- AN OBSERVATIONAL STUDY

Dr. Salwa Bavikara Maniyankod¹, Dr. Subramanya Shetty², Dr. Minaz³, Dr. Kevin Joseph Nirayath⁴

¹Postgraduate, Department of Orthodontics and Dentofacial Orthopedics, Yenepoya dental college, Yenepoya (Deemed to be University), Mangalore

²Professor, Department of Orthodontics and Dentofacial Orthopedics, Yenepoya dental college, Yenepoya (Deemed to be University), Mangalore

³Senior Lecturer, Department of Orthodontics and Dentofacial Orthopedics, Yenepoya dental college, Yenepoya (Deemed to be University), Mangalore

⁴Senior Lecturer, Department of Orthodontics and Dentofacial Orthopedics, Yenepoya dental college, Yenepoya (Deemed to be University), Mangalore

Abstract:

Objective: This study is aimed at assessing the efficiency of SORTECH DUPLOSLOT® brackets and single slot standard 0.022x0.028 MBT bracket system in decrowding of teeth.

Materials and methods: The sample of 42 participants were taken which included participants undergoing fixed orthodontic treatment with SORTECH DUPLOSLOT® brackets in the mid crown position with 0.022x0.028 as primary slot and participants undergoing fixed orthodontic treatment single slot standard 0.022x0.028 MBT bracket system as decided by the treating dental practitioner. The participants selected had crowding more than 5mm according to little's irregularity index. **Results:** The results showed that the rate of decrowding was similar in both the groups, there was no significant difference in inter-canine, inter-premolar and inter molar width between both the groups. **Conclusion:** Double slot SORTECH DUPLOSLOT® brackets and single slot standard 0.022x0.028 MBT bracket system have similar characteristics during initial levelling and aligning, however, the greatest clinical advantage of using double slot brackets comes into play when there is a need for technique sensitive procedures such as, overlay mechanics, intrusion and when there is a need for mesialisation of posterior teeth.

Keywords: decrowding, Duploslot brackets, double slot

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Introduction: The first phase of fixed appliance in orthodontic treatment is concerned with tooth alignment. The underlying tissue biology play a significant role, the response of the periodontium to the applied orthodontic force provides the fundamental mechanism that allows

tooth movement through alveolar bone. Although the biologic factors are largely outside the control of the orthodontist, more direct influence can be achieved with the choice of bracket system and arch wire¹.

Dr. Edward Angle, 1925 introduced the edgewise orthodontic appliance system and proposed the 0.022-inch by 0.028-inch bracket slot size, which allows better control of crown and root position¹. The gold wires which were used in earlier days are replaced by stainless steel wires nowadays which are cost effective². These wires due to their difference in thickness, reduced the bracket slot size to 0.018-inch but did not preclude the 0.022 slot brackets³.

The evolution of bracket design began with the ribbon arch technique with the vertically positioned slot and evolved with the use of rectangular horizontal slots in the edgewise system, and now, to the self-ligating bracket system⁴. Despite the numerous bracket designs, one feature has been unchanged that there is only one single horizontal slot on the facial facet of the bracket. But in Tip-Edge Plus, In-Ovation and R⁴ brackets, an additional horizontal slot is enclosed within the bracket base and is not open to the labial surface, therefore only allowing for engagement of segmental auxiliary archwires⁵.

The Conventional Double Slot Bracket (DSC), introduced in 2018, is a new design with a main feature of presence of two main slots located in the center of the piece with different dimensions which make them unique. The idea of working with two slots in a conventional bracket (bracket without a clip) made it possible to join two treatment systems. Nowadays, the DSC presents the cervical slot with dimensions of 0.018 ||X 0.030|| and the occlusal / incisal slot 0.022 ||X 0.028||. The union of these two measures / systems made the DSC a bracket with two dimensions in the same piece, which is now considered a two-dimensional bracket⁶.

The presence of an extra slot in a piece allows the use of a combination of orthodontic arch wires that was not possible till then. This new device has advantage of: work with two arch wires at the same time; Work only with the 0.018 ||X 0.030|| slot; Work only with the 0.022 ||X 0.028|| slot; Use different dimensions of alloys and arch diameters at the same time for specific movements; Allow new methods of anchoring; Use segmented arch together with continuous arches; Make atypical combinations for specific cases; Vary the slots for vertical movements, work with the Two-dimensional Technique and infinite other possibilities⁷.

This study was designed to observe the treatment efficiency on participants undergoing fixed orthodontic treatment for decrowding of teeth. The comparison was between SORTECH DUPLOSLOT® bracket system (a bracket with two bracket slots of different slot dimensions) and single slot standard 0.022||x0.028|| MBT bracket system.

Materials and methodology: This study was done by observing treatments given to patients reporting to Department of Orthodontics and Dentofacial Orthopedics, Yenepoya Dental College, Mangalore, various malocclusion with a good periodontal health.

I. INCLUSION CRITERIA:

- Participants between the age group of 18-34years
- Participants with good periodontal health.
- Participants with crowding more than 5mm (according to little 's irregularity index) and requiring extraction for decrowding.

J. EXCLUSION CRITERIA:

- Participants with gross skeletal deformity such as craniofacial anomalies
- Non-extraction cases i.e, generalized spacing cases or patients not requiring extractions for decrowding of teeth.
- Cleft lip and palate participants

STUDY TOOL:

Pre-treatment and intermediate intraoral photos of participants treated with SORTECH DUPLOSLOT® brackets and single slot standard 0.022x0.028 MBT bracket system. Pre-treatment and intermediate study casts of participants treated with SORTECH DUPLOSLOT® brackets and single slot standard 0.022x0.028 MBT bracket system.

METHODOLOGY

The sample of 42 participants were taken which included participants undergoing fixed orthodontic treatment with SORTECH DUPLOSLOT® brackets in the mid crown position with 0.022x0.028 as primary slot and participants undergoing fixed orthodontic treatment single slot standard 0.022x0.028 MBT bracket system as decided by the treating dental practitioner.

Every participant was identified with a code consisting of an alphabet and a number. The Alphabet assigned was A' for participants bonded with SORTECH DUPLOSLOT® brackets and B' for participants bonded with single slot standard 0.022x0.028 MBT bracket system. The numbers were assigned from 1 to 21 according to the participant recruited.

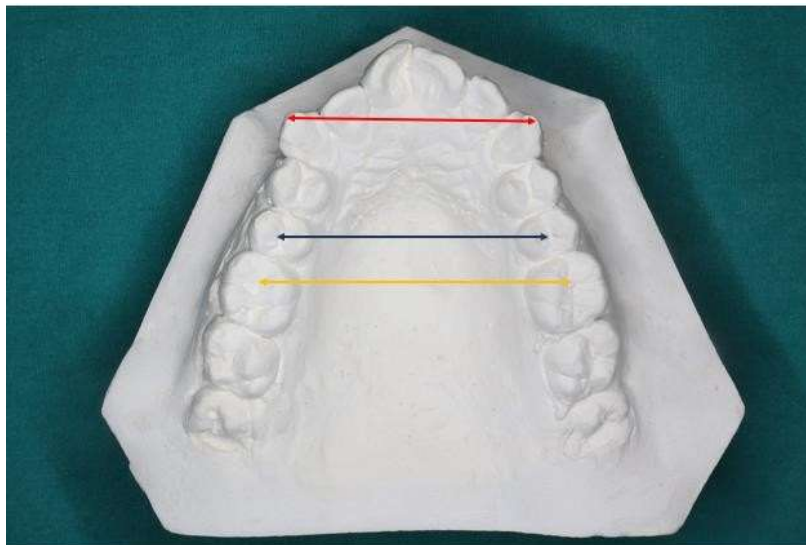
All the 42 participants were reviewed approximately every 4weeks by the dental practitioner. Both the groups were subjected to initial levelling and aligning done using round wires. The wires were incrementally proceeded, i.e, after decrowding in 0.014 NiTi, arch wire was stepped upto 0.016 NiTi, and then to 0.018 NiTi. The wire was completely engaged within the bracket slot of their respective brackets.

Both upper and lower dental casts were made before appliance placement i.e., T0, second study cast was made after alignment with 0.014-inch arch wire (T1), and the final study cast was made after alignment with 0.018-inch wire (T2).

The initial rate of alignment was measured from the difference in the irregularity index of serial casts taken at T0 and T1 using digital Vernier caliper, divided by the number of days between the two measurements. Similar was followed for T1 and T2. The overall rate of alignment was measured from the difference in the irregularity index of serial casts taken at T0 and T2 using digital Vernier caliper, divided by the number of days between the 2 measurements.

Dental study cast pretreatment T0 and at the end of alignment T2 was used to determine the change in the transverse measurements (inter-canine, inter-premolar and inter-molar width). Inter-canine width was measured as the distance between the cusp tips of the canines, inter-premolar width is the distance between the central occlusal pit of the premolars and intermolar width measured at the central occlusal pit on the mesial fossa of the first molar using digital Vernier caliper (figure 1).

Figure 1. Measurement of intercanine, inter-premolar and intermolar width



To avoid subject errors and subjective bias double blinding technique was used. To avoid errors in measurement, the measurements were repeated after 10 days, and the average of both the values were recorded. The results of the group A and group B were compared and recorded.

Statistical analysis: The descriptive statistics was used and the collected data were analysed in the SPSS software (IBM, Chicago, IL, version 25.0). Mean and Standard deviation was calculated for continuous data. The frequency and percentage for categorical data was used. Independent sample t test was used to compare double slot SORTECH DUPLOSLOT® brackets and single slot standard 0.022|x0.028| MBT bracket system. Paired t test was used to compare the means within the group.

Results: Records of 42 patients who reported to the Department of Orthodontics and Dentofacial Orthopaedics who required orthodontic correction for malocclusion were used for this study. These records were obtained from the respective treating dental practitioner. The mean and standard deviation of the double slot SORTECH DUPLOSLOT® brackets and single slot standard 0.022-inch MBT brackets in participants were mentioned in table 1.

Table 1: The overall Mean and SD of the double slot SORTECH DUPLOSLOT® brackets and single slot standard 0.022-inch MBT brackets

		Group A		Group B	
		Mean	SD	Mean	SD
Little's irregularity index	T0	6.6960	0.62368	6.4430	0.82697
	T1	2.3360	0.91527	2.2190	0.61581
Time taken (No.of days) for	Initial alignment	56.90	6.313	58.40	4.433
	Overall alignment	146.10	23.620	145.30	20.953
Inter canine width (in mm)	T0	35.4160	3.14666	34.8400	2.09176
	T1	35.4330	2.70693	36.143	1.58180
Inter premolar width (in mm)	T0	33.6000	2.28965	32.4370	3.07167
	T1	37.7850	1.29325	37.3170	1.54799
Inter molar width (in mm)	T0	43.9030	3.04089	43.9660	2.01011
	T1	45.2160	2.64593	43.4130	1.89942

The difference in Little's Irregularity Index of the double slot SORTECH DUPLOSLOT® brackets and single slot standard 0.022-inch MBT brackets in participants using Independent T test were mentioned in table 2. No significant differences were observed between the groups.

Table 2. Difference in Little's irregularity index between groups using independent T test.

	Group	N	Mean	Std. Deviation	Std. Error Mean	t value	p value
T0	Group A	21	6.7860	0.62368	0.19406	1.062	0.312
	Group B	21	6.4430	0.82697	0.25835		
T1	Group A	21	2.4260	0.91527	0.28627	0.601	0.565
	Group B	21	2.2190	0.61581	0.19158		

The difference in time taken (No of days) for initial alignment and overall alignment for the double slot SORTECH DUPLOSLOT® brackets and single slot standard 0.022-inch MBT brackets in participants using independent T test were mentioned in table 3. No significant differences were observed between the groups.

Table 3. Difference in time taken (No of days) between groups using independent T test.

	Group	N	Mean	Std. Deviation	Std. Error Mean	t value	p value
Initial alignment	Group A	21	56.90	6.313	1.994	-0.617	0.547
	Group B	21	58.40	4.433	1.400		
Overall alignment	Group A	21	147.00	23.620	7.467	0.171	0.868
	Group B	21	145.30	20.953	6.624		

The difference in intercanine width for initial alignment and overall alignment for the double slot SORTECH DUPLOSLOT® brackets and single slot standard 0.022-inch MBT brackets in participants using independent T test were mentioned in table 4. No significant differences were observed between the groups.

Table 4. Difference in intercanine width between groups using independent T test.

	Group	N	Mean	Std. Deviation	Std. Error Mean	t value	p value
T0	Group A	21	35.4160	3.14666	.99290	0.485	0.635
	Group B	21	34.8400	2.09176	.65931		
T2	Group A	21	35.4330	2.80693	.88547	-0.701	0.494
	Group B	21	36.1430	1.58180	.49805		

The difference in interpremolar width for initial alignment and overall alignment for the double slot SORTECH DUPLOSLOT® brackets and single slot standard 0.022-inch MBT brackets in participants using independent T test were mentioned in table 5. No significant differences were observed between the groups.

Table 5. Difference in interpremolar width between groups using independent T test.

	Group	N	Mean	Std. Deviation	Std. Error Mean	t value	p value
T0	Group A	21	33.6000	2.28965	.72189	0.964	0.349
	Group B	21	32.4370	3.07167	.96918		
T2	Group A	21	37.7850	1.29325	.40680	0.740	0.471
	Group B	21	37.3170	1.54799	.48735		

The difference in intermolar width for initial alignment and overall alignment for the double slot SORTECH DUPLOSLOT® brackets and single slot standard 0.022-inch MBT brackets in participants using independent T test were mentioned in table 6. No significant differences were observed between the groups.

Table 6. Difference in intermolar width between groups using independent T test.

	Group	N	Mean	Std. Deviation	Std. Error Mean	t value	p value
T0	Group A	21	43.9030	3.04089	.95945	-0.056	0.958
	Group B	21	43.9660	2.01011	.63349		
T2	Group A	21	45.2160	2.65593	.83772	1.755	0.098
	Group B	21	43.4130	1.89942	.59849		

Discussion: Tooth Alignment generally appear to be the most important preliminary clinical phase of any orthodontic treatment with fixed orthodontic appliances. During the alignment stage, tooth movement is directly affected by many factors, such as interbracket distance, bracket width, archwire selection and the friction generated between the bracket and the archwire. It is critical that the force moment which generated by interaction between the bracket slot and the archwire to be transferred from the archwire to the malpositioned tooth⁸.

The Conventional Double Slot Bracket or SORTECH DUPLOSLOT® bracket, developed in 2018, is a new design of orthodontic bracket which contains two main slots located in the center of the piece. These two slots have different dimensions with cervical slot 0.018 ||x 0.030|| and the occlusal / incisal slot 0.022 ||x 0.028||, which makes this device something unique in

orthodontics worldwide. The idea of working with two slots in a conventional bracket (bracket without a clip) made it possible to join two treatment systems. This study was aimed at assessing the efficiency of SORTECH DUPLOSLOT® brackets in decrowding by comparing it with standard MBT 0.022-inch brackets.

The initial rate of alignment for experimental and test groups were measured from the difference in the irregularity index of serial casts taken at T0 and T1 using digital Vernier caliper, divided by the number of days between the two measurements. There were no significant difference in the Little's irregularity index between the double slot SORTECH DUPLOSLOT® brackets and single slot standard 0.022-inch MBT brackets which showed that the alignment efficiency was almost similar for both bracket groups. This is in accordance with the study by Vu et al⁹ and Detterline et al¹⁰ in which there was no significant difference in alignment efficiency between two different slot dimensions whereas Shen et al¹¹ study showed that the twin brackets showed improved alignment efficiency when compared with single slot brackets.

There was no significant difference in the time taken for initial and final alignment between the double slot SORTECH DUPLOSLOT® brackets and single slot standard 0.022-inch MBT brackets in participants which showed that the duration of alignment was almost similar for both the bracket groups. This is in accordance with the study by Vu et al⁹ and Detterline et al¹⁰ in which there was no significant difference in duration of alignment between two different slot dimensions whereas Cobb et al¹² study showed that the .022 brackets showed 1-month earlier alignment efficiency when compared with .018 slot brackets.

There was no significant difference in the Inter canine width (in mm) between the double slot SORTECH DUPLOSLOT® brackets and single slot standard 0.022-inch MBT brackets in participants which showed that the alignment efficiency was almost similar for both bracket groups. This is in contrast with the study by Shen et al¹¹ in which, in the twin-slot bracket group, the treatment changes in the canine position by derotation and uprighting were 40 ± 3 and 25 ± 2 degrees, respectively, compared with 20 ± 5 and 10 ± 2 degrees in the edgewise group ($P < 0.01$). The twin-slot bracket significantly increased the bracket width without reducing the interbracket span and therefore can generate increased force moments within the bracket, leading to an improved manipulation in tooth repositioning.

There was no significant difference in the Inter premolar width and intermolar width between the double slot SORTECH DUPLOSLOT® brackets and single slot standard 0.022-inch MBT

brackets in participants which showed that the alignment efficiency was almost similar for both bracket groups.

The results from this study indicated that double slot SORTECH DUPLOSLOT® brackets and single slot standard 0.022x0.028 MBT bracket system have similar characteristics during initial levelling and aligning, however, the greatest clinical advantage of using double slot brackets comes into play when there is a need for technique sensitive procedures such as, overlay mechanics, intrusion and when there is a need for mesialisation of posterior teeth.

Conclusion:

- The time taken for initial and overall levelling and alignment were similar for both double slot SORTECH DUPLOSLOT® brackets and single slot standard 0.022-inch MBT brackets. No significant difference in both the groups.
- The inter-canine, inter premolar and inter molar width increased at the end of the initial levelling and aligning double slot SORTECH DUPLOSLOT® brackets and single slot standard 0.022-inch MBT brackets. However, comparison of these parameters between the two groups showed no significant difference, concluding that there was similar increase in width in inter canine, inter-premolar and intermolar width for both the groups.
- The change in inter-canine, inter-premolar and intermolar width for was both double slot SORTECH DUPLOSLOT® brackets and single slot standard 0.022-inch MBT brackets was not significant.

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