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EVALUATION DOUBLE SLOT BRACKETS VS SINGLE SLOTS FOR FIRST STAGE ORTHODONTIC TREATMENT BY PAR AND ABO INDICES

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Abstract:
The goal of the initial stage of orthodontic therapy, alignment, is to realign the teeth's contact sites by correcting rotations and crowding. Two of the most popular indices for orthodontic treatment outcome are the Peer Assessment Rating (PAR) index and the American Board of Orthodontics (ABO) Objective Grading System ,This study was designed to observe the treatment efficiency between double slot (double wire) and single slot (single wire) on participants undergoing fixed orthodontic treatment for leveling and alignment. This randomized clinical trial (observational study) was conducted on Patients awaiting treatment at the College of Dentistry at Hawlere Medical University . All patients who gave verbal and written informed consent were included in the study, which was approved by the ethics committee of the Hawler Medical University College of Dentistry after was registered by Sri Lanka Clinical Trials (SLCTR/2022/015.). After properly diagnosing . using digital cephalometry, OPG, intraoral and extraoral photos, and intra-oral scanning of each patient was held before starting treatment and after 3month of of alignments. There was no statistically significant differences between single and double wire cases regarding PAR and ABO parameters before intervention, p-values were more than 0.05. for both indices. The results showed that there was no statistically significant difference between these two methods of alignment according to PAR index statistically showed nonsignificant while for ABO showed significant difference.

Key words: Alignment leveling, double archwire

Introduction: Any orthodontic treatment plan's primary goal is typically alignment, So goal of the initial stage of orthodontic therapy, alignment, is to realign the teeth's contact sites by correcting rotations and crowding. (1-4).
Tooth movement depends on the application of orthodontic forces (3, 5). These forces induce many changes in the periodontal ligaments, resulting in bone and periodontal tissue remodeling(6-8) Fixed orthodontic appliances use brackets and different types of archwires to deliver forces on teeth. Light and continuous forces are required to achieve tooth movement with minimum patient discomfort and pathological effects on the teeth and their surrounding structures. In the early stages of treatment,

lighter and more flexible aligning archwires are used to correct teeth crowding and rotations. Due to variation in archwires, it is important for the orthodontist to understand the optimal properties for all of the available archwires in order to choose the most appropriate and effective type(9, 10).

Aligning teeth is the primary goal of the fixed appliance phase of orthodontic therapy. The essential mechanism that permits tooth movement through alveolar bone is provided by the periodontium's response to the orthodontic force, which is influenced by the underlying tissue biology. Even though the orthodontist has little control on biologic parameters, selecting the right bracket system and arch wire can have a more direct impact(11-13).

The ribbon arch technique, which used a slot positioned vertically, was the first in the history of bracket design. Later, the edgewise system used rectangular horizontal slots, and finally, the self-ligating bracket system(11, 14, 15).

Introduced in 2018, the Conventional Double Slot Bracket (DSC) is a novel design featuring two major slots in the centre of the component that are unique due to their differing dimensions. Two treatment systems might be connected thanks to the concept of using two slots in a traditional bracket—that is, a bracket without a clip. Nowadays, the DSC presents the cervical slot with dimensions of 0.018 ǁX 0.030ǁ and the occlusal / incisal slot 0.022 ǁX 0.028ǁ. The merger of these two measures / systems made the DSC a bracket with two dimensions in the same piece, which is today regarded a two-dimensional bracket (5, 10, 16).

A combination of orthodontic arch wires that was not before conceivable is now possible due to an additional slot in a piece. Benefits of this innovative gadget include: concurrently operate with two arch wires; Utilise distinct alloy dimensions and arch diameters concurrently for particular movements; Work only with the 0.018 ǁX 0.030ǁ and 0.022 X 0.028ǁ slots; Permit innovative anchoring techniques. Employ both continuous and segmented arches together; Combine unusual elements in particular situations; Infinite more options include experimenting with the two-dimensional technique and changing the slots to allow for vertical movements.(11, 17-19)

The trade-off between these two opposing factors—the maximum bracket width with the appropriate interbracket span—thus becomes one of the key factors influencing bracket design.

It is generally acknowledged that a broad bracket can only be as wide as half of a tooth in breadth.(20, 21).

According to Shen (22), the double-slot bracket considerably widened the bracket without shortening the space between the brackets, which results in enhanced the bracket's force moments, which result in a better technique for moving teeth around.

Two of the most popular indices for orthodontic treatment outcome are the Peer Assessment Rating (PAR) index and the American Board of Orthodontics (ABO) Objective Grading System (OGS).(23-25)

The Peer Assessment Rating (PAR) index is particularly well-known among the quantitative indices that have been established to assess orthodontic treatment needs and outcomes(21, 26).

Widely utilized in orthodontics, the PAR index is a valuable tool for assessing the severity of malocclusions and measuring the efficacy of treatment interventions in addressing them. Its creation in 1987 resulted from a collaborative effort involving ten seasoned orthodontists constituting the British Orthodontic Standards Working Party (26, 27)

The OGS is a more robust method of outcomes, which evaluates posttreatment dental models according to 8 different components: alignment, marginal ridges, buccolingual slope occlusal relationships, occlusal contacts, overjet, interproximal contacts, and root angulation. For measurements, a metal gauge is used. (25, 28).

This study was designed to observe the treatment efficiency between double slot (double wire) and single slot (single wire) on participants undergoing fixed orthodontic treatment for leveling and alignment .

The comparison was between SORTECH DUPLOSLOT® bracket systemmeans using double wire (a bracket with two bracket slots of different slot dimensions) versus single wire by Peer assessment Rating index.

Material and methods:

This randomized clinical trial (observational study) was conducted on Patients awaiting treatment at the College of Dentistry at Hawlere Medical University.

All patients who gave verbal and written informed consent were included in the study, which was approved by the ethics committee of the Hawler Medical University College of Dentistry after was registered by Sri Lanka Clinical Trials (SLCTR/2022/015.)

After properly diagnosing. using digital cephalometry, OPG, intraoral and extraoral photos, and intra-oral scanning of each patient was held before starting treatment and after 3month of alignments.

Inclusion criteria

7. mild to moderate crowding (PAR indices between (4 – 13) were chosen,
2- Motivated and cooperative. patients between 18-23 years old According to patient reports, there is no systemic sickness or a healthy systemic status.
3. Not using any kind of anti-inflammatory medication before the start of the research.
4. Maintaining good dental hygiene and periodontal health.
5.With every tooth present in the permanent dentition (Except 3rd molars)
6. Class II division 1 incisor relationship where the overjet is 6.0 mm or less (an upper tooth which was in crossbite was accepted provided the orthodontic bracket could be bonded to the tooth and no additional space opening mechanics were needed to align the tooth).
7. There was no discernible radiographic bone loss on the dental picture cone beam computed tomograph (CBCT).

Criteria for exclusion

1. Prior orthodontic treatment .
2. Individuals with sever malocclusion and impacted teeth
3. Individuals suffering from syndromic illnesses, such as cleft lip and palate, or hyper- or hypodontia.
4. non-cooperative patients.

Sample size and randomization :

In the current research, 40 patients (23females and 17males) between the ages of 18 and 23 years old with class II malocclusion (overjet less than 6 mm and over bite between 4 and 0 mm) were selected from patients seeking orthodontic treatment after proper diagnosing using digital cephalometry, OPG, intraoral and extraoral photo, an intraoral scan. All participants gave their consent in writing after being fully informed. 40 coded packets (20 DW=double wire and 20 SW=single wire) were placed in a box. After mixing, the patients randomly and with closed selection were placed in two groups (double wires and single wire group).

Patients did not know which group they belonged to. The treating orthodontist was also partly blinded between groups because he did not know which envelopes contained double wires and which contained single wires. However, because of the therapy nature, the treating orthodontist was aware of whether the patient was allocated to DW or SW.

Interventions:

One clinician (MI) treated all patients under the lead investigator's (BA) supervision after each patient received a standard orthodontic assessment. The subjects received instruction on proper oral hygiene practises and underwent full-mouth scaling and prophylaxis prior to the commencement of treatment.

Preparation of digital models and indices (PAR and ABO) measurement:

A digital model was produced using an intraoral scanner Medit i700 made in seoul,south korea) After calibration and sterilization scanner tip was placed onto the scaneer and covered by disposable nylon except for the mirror site to avoid accuracy and foggy .

the examiner started to scan the patient dentition according to the manufacturer’s instructions

Moments before either bracket system was bonded in place, baseline (T0) before and (T1) after three month of treatment (before starting and 3month of treatment) figure (1) .

After scanned of upper and lower jaw we taken digital bite record as The scanning bite of samples was mandatory step for three dimensional analysis of digital casts in orthoanalyzar software The scan was saved in standard tessellation language (STL).

The digital models were imported into OrthoAnalyzer software for PAR and ABO indices measurement (fig 2) . to be able to use the scoring system in the OrthoAnalyzer software we performed necessary preparation like segmentation of teeth (just the ones requiring for questionnaire) , standard plane set and measure over jet and over bite for central and lateral incisors

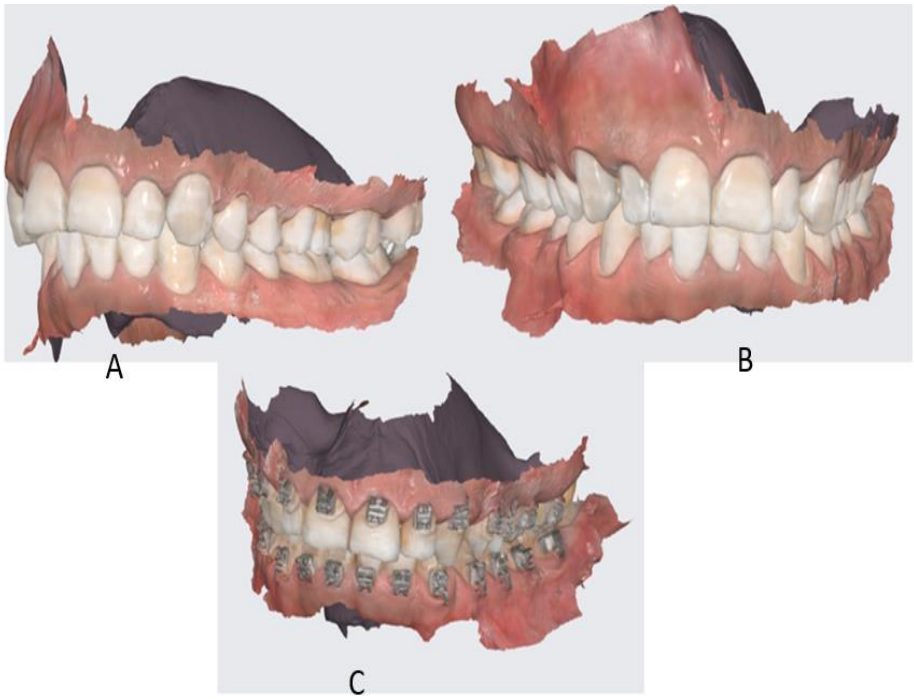

Fig.(1) A & B digital model of upper and lower jaw before bracket placement with digital bite record , C after three month of alignment..

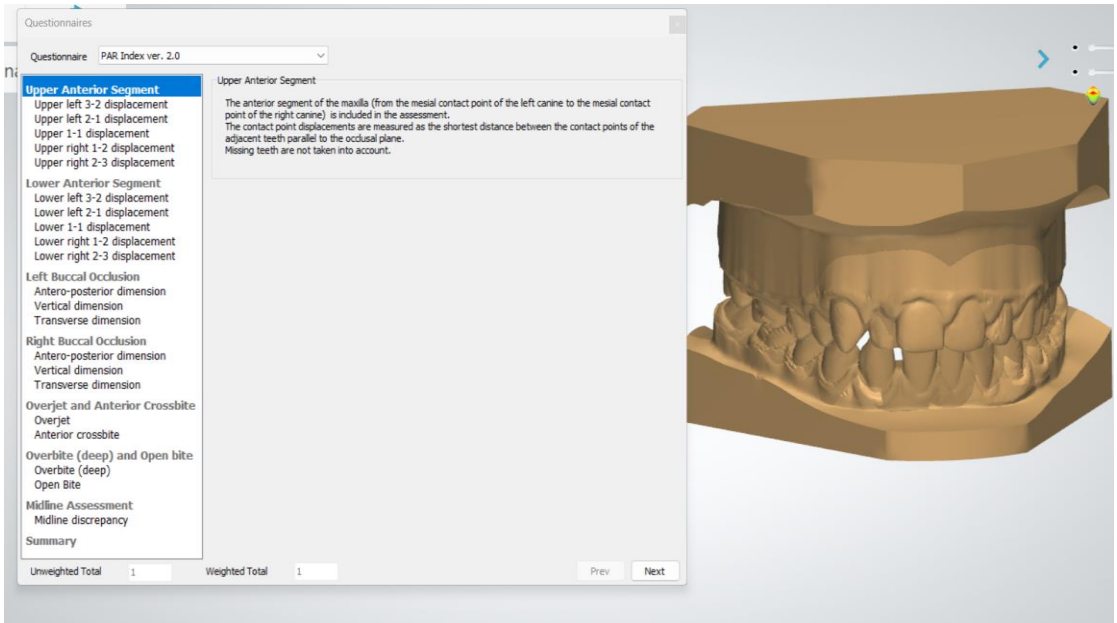

Figure 2: Peer Assessment Rating (PAR) index scoring using Ortho Analyzer

softwaLeveling and Alignment procedure :
During the procedure, the teeth were polished with pumice and water, etched with 37% phosphoric acid, and for standardization all patients bonded with double slot conventional brackets (sortech company) .
Random assignment was used to place the participants in one of the two trial groups . The arch wire sequence for each group looked like this:
A. Adouble wire (DW) groups : the arch wires sequence for this group looked like this :
First month : insertion 0.014 A NiTi wires (American Orthodontics, Sheboygan, Wisconsin, USA) as initial arch wire in the occlusal slot and 0.012 a NiTi wires in the gingival slot for one month .
Second month: the second vist we stepped to 0.016 A NiTi wires (American Orthodontics, Sheboygan, Wisconsin, USA) as initial arch wire in the occlusal slot and 0.014 a NiTi wires in the gingival slot for one month .
3rd month : in the 3rd vist applied 0.018 A NiTi wires (American Orthodontics, Sheboygan, Wisconsin, USA) as initial arch wire in the occlusal slot and 0.016 a NiTi wires in the gingival slot for one month.

B- A single wire (SW) groups : the arch wires sequence for this group looked like this :
First month : insertion 0.014 A NiTi wires (American Orthodontics, Sheboygan, Wisconsin, USA) as initial arch wire in the occlusal slot for one month .
Second month: the second vist we stepped to 0.016 A NiTi wires (American Orthodontics, Sheboygan, Wisconsin, USA) arch wire in the occlusal for one month .
3rd month : in the 3rd vist applied 0.018 A NiTi wires (American Orthodontics, Sheboygan, Wisconsin, USA arch wire in the occlusal slot also for one month .
Following three months of alignment and levelling, a second intraoral scan was performed to get a second digital model for comparison with the first.

Results: For the current study, 40 patients in all were enrolled , however 3 patients (2 from single and one from double)were removed from the trial because of failure to attend the clinic at the periods of alignment split, into two groups. Twenty patients were selected at random to get single slot bracket treatments (single wire cases), whereas the remaining twenty patients received double slot bracket treatments (double wire cases).
According to data shown in table 1 female made up the majority of cases (55%), while male made up 45%. Records of 40 patients who required orthodontic correction for malocclusion were used for this study. These records were obtained from the respective treating dental practitioner.

Table 1: participants sex.

Gender	Frequency	percent
Male	18	45.0
Female	22	55.0
Total	40	100

There was no statistically significant differences between single and double wire cases regarding PAR and ABO parameters before intervention, p-values were more than 0.05. for both indices as shown in table 2

Table 2 Par indices and ABO indices before intervention.

Variables	Type of wire	N	Mean	Std. Deviation	p-value	t-test
PAR before unweighted	Single wire	18	8.70	2.494	0.621	Non-significant
	Double wire	19	9.15	3.167		
PAR before weighted	Single wire	18	15.75	5.159	0.170	Non-significant
	Double wire	19	17.80	4.034		
ABO before intervention	Single wire	18	9.55	2.762	0.409	Non-significant
	Double wire	19	10.20	2.118		

The range, minimum , maximum 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 3.

Table 3 : summary of the range ,minimumum maximum mean and standerdeviation of PAR and ABO indices before and after intervention.

Table 3 :Descriptive Statistics of study sample

Variables	N	Range	Minimum	Maximum	Mean	Std. Deviation
Age	37	5.0	18.0	23.0	20.77	1.61
PAR before unweighted	37	9	4	13	8.93	2.82
PAR after unweighted	37	8	2	10	5.13	2.22
PAR before we.	40	14	8	22	16.18	4.94
PAR after weight	37	14	3	17	9.63	3.49
ABO before	40	8	6	14	9.88	2.45
ABO after	37	8	4	12	6.92	1.97
PAR Red	37	11	2	13	6.35	3.00
PAR%	37	48.48	18.18	66.67	39.17	12.20
ABO	37	6	1	7	2.95	1.239

In table 4 The results indicated that, while the ABO provided significant outcomes, the PAR index statistically showed nonsignificant differences between these two alignment approaches.

Table 4: Comparison between single and double wire cases in age, PAR, PAR% and ABO measures.

Measure	Type of wire	N	Mean	Std. Deviation	p-value	t-test
age	Single wire	20	21.000	1.5894	0.385	Non-significant
	Double wire	20	20.550	1.6456		
PAR Red	Single wire	20	5.90	3.194	0.349	Non-significant
	Double wire	20	6.80	2.802		
PAR%	Single wire	20	39.82	10.68	0.744	Non-significant
	Double wire	20	38.53	13.81		
ABO	Single wire	20	2.55	.826	0.041	Significant
	Double wire	20	3.35	1.461		

Table 5 :Single wire cases Comparison of before and after intervention measures.

Measure	Mean	N	Std. Deviation	p-value	t-test
PAR before unweighted	8.70	20	2.494	0.001	Highly significant
PAR after unweighted	5.00	20	2.077		
PAR before weighted	14.55	20	5.316	0.001	Highly significant
PAR after weighted	8.65	20	3.422		

ABO before	9.55	20	2.762	0.001	Highly significant
ABO after	7.00	20	2.362		

Table 6:Double wire cases Comparison of before and after intervention measures.

Measure	Mean	N	Std. Deviation	p-value	t-test
PAR before unweighted	9.15	20	3.167	0.001	Highly significant
PAR after unweighted	5.25	20	2.403		
PAR before weighted	17.80	20	4.034	0.001	Highly significant
PAR after weighted	10.60	20	3.362		
ABO before	10.20	20	2.118	0.001	Highly significant
ABO after	6.85	20	1.565		

Discussion:

The purpose of this research was to ascertain whether there are any clinical differences in alignment efficiency between double slot (double wires) and single slot orthodontic brackets (single wire) .

The PAR and the OGS can be considered as mechanical systems of measurement that are incapable of evaluating all orthodontic treatment outcomes. Previous authors describe occlusal indices as measures of orthodontic outcomes(29, 30).

Generally when two forces are applied in the same direction to an item (like teeth) but with different moments (torques). The magnitudes, directions, and places at which the forces are applied will determine the overall effect on the item. Forces and torques can have many consequences when it comes to teeth (31, 32) .

In the present study we applied the force in two different way for correcting leveling and alignment in one group we applied force by single wire (0.014 niti) but in the second group we used two wire (one 0.014 niti second 0.012 niti) at the same time so in second group we increased the forces over 1.5 when compared with first group, however, When two forces act in the same direction, they add together. The combination of all the forces acting on an object is the net force. This mathematical law for free object but tooth not free object so difference,

We compared outcome treatment with PAR and ABO index While it isn't without its limitations, the PAR index is a reliable and valid method of assessing orthodontic treatment outcomes. Despite the development of ICON, which could effectively supersede it, the PAR index remains the most widely accepted such tool and plays a vital role in commissioning and monitoring the quality of NHS orthodontic treatment provision.(27)

The results showed that there was no statistically significant difference between these two methods of alignment according to PAR index statistically showed nonsignificant while for ABO showed significant difference.

This difference between these two measurement may be due to that, ABO-OGS measures individual teeth and adds points based on the deviation distance (mm), while PAR analyzes segment units, such as the upper anterior segment and left lateral segment, and adds points based on definitions, for example one point for a "one-quarter to onehalf lower incisor width" deviation of midline . the inter-arch coordination evaluation criteria from each tooth, such as the "overjet" and the "occlusal relationship" are more meticulous in the ABOOGS (32)This seemed to be the reason why there was statically difference in outcome alignment improvent between ABO and PAR indices.

The NiTi wire was the only one which significantly improved the crowding . When comparing double wire with single wire however, no evidence was found with regard to the efficiency in leveling and aligning . It was concluded that clinical factors, such as the loading pattern of the archwires, may effectively eliminate the advantages double wire compared with single wire . also The force systems generated by placing straight wires into crooked brackets may or may not result in favorable tooth

movement depending on the geometric relationships among the brackets and the outcome desired (33-35).
It's critical to remember that, in a biological context, the teeth are fixed in the jawbone and that, in addition to the surrounding tissues and jaw structure, other factors that affect their movement include the existence of braces and other dental equipment.To sum up, the precise result of exerting forces and torques on teeth is contingent upon the specifics of the forces, including their amounts, orientations, and sites of application. Professionals in the dental or biomechanical fields, like orthodontists, take these variables into account when designing treatment plans to guarantee the intended result without endangering the teeth or surrounding structure.(36-38).
HONG M etal . Compared Treatment Outcome Assessment for Class I Malocclusion Patients PAR index versus ABO index they found that d there was no significant correlation between PAR-percentage reduction and ABO-objective grading system for malocclusion they said It became apparent that PAR and ABO-OGS are different approaches to outcome assessment treatment

Conclusion:
The results of the present study showed that there was a no significant difference in leveling and alignment between the two groups with PAR index , but there is a significant difference with ABO index. double slot bracket showed more effective treatment than single slot brackets.

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