IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 22, Issue 7 Ser.1 (July. 2023), PP 29-35
www.iosrjournals.org

Comparative Assessment Of Treatment Outcomes Between The Conventional And Customized Labial Bracket System

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Abstract:
Background*: Customized Bracket System Provides High Precision, An Optimum Orthodontic Result, With Less Chair Time, And A Predictable Treatment Course Is Helpful. The Customized System Requires The Orthodontist To Prepare It Over A Longer Period Of Time Than The Traditional Method Does. It Takes Several Steps To Set Up A Treatment Plan With The Customized Bracket System, Including Modification By An Orthodontist And A Technician. However, The Prolonged Planning Period Resulted In A Superior Treatment Outcome. Effective Treatment Planning And Preparation Can Cut Down On The Amount Of Chairside Time.*
Materials And Methods*: In This Prospective Study, The Study Was Carried Out In A Sample Size Of 14 Patients. All Patients Above The 13 Years Of Age Were Considered For The Study. The Study Was Carried Out In The Department Of Orthodontics, ITS Dental College, Greater Noida. The Study Group Comprised Patients With Bimaxillary Protrusion. The Sample Consisted Of 14 Bimaxillary Protrusion Malocclusion Cases Which Were Randomly Divided Into Two Groups. Group I And II Each Group Consisted Of 7 Patients. Group I Was Conventional Bracket System Group And Group II Was Customized Bracket System Group. The Sample Were Sourced From The OPD Of The I.T.S Dental College And Research Center, Greater Noida.*
Results*: The Mean Number Of The Wires Required For The Levelling And Aligning Was Lesser In The Customised Group (3.142) As Compared To The Conventional Group (2.857). The Difference Between The Groups Was Statistically Non-Significant With P Value Of 0.454 The Mean Duration (Minutes) Of The Bonding Was Lesser In The Customised Group (24.857) As Compared To The Conventional Group (12.142). The Difference Between The Groups Was Statistically Significant With P Value Of 0.001. The Mean Duration (Months) Of The Space Closure Was Lesser In The Customised Group (9.785) As Compared To The Conventional Group (6.571). The Difference Between The Groups Was Statistically Significant With P Value Of 0.001. The Mean Anchorage (Measured In Millimetre) Loss Was Lesser In The Customised Group (3.000) As Compared To The Conventional Group (1.642). The Difference Between The Groups Was Statistically Significant With P Value Of 0.001*
Conclusion: *The Efficacy Of Customised Labial Bracket System Was Significantly Higher Than The Conventional Bracket System.*
Key Word*:Customized Bracket System, Conventional Bracket System, Tip And Torque.*

Date of Submission: 22-06-2023 Date of Acceptance: 02-07-2023

I. Introduction

Customized brackets with tip and torque values based on the patient, and one of the most recent CAD/CAM developments in the field is robotically bent arch wires. The use of 3D technology enables the practitioner to better identify case objectives and visualize treatment outcomes by utilizing virtual treatment planning software in addition to the precise and customized milling of orthodontic appliances.

It is advantageous for an orthodontist to use a system that offers high precision, an ideal orthodontic result, with less chair time, and a predictable treatment course. When compared to the conventional system, the customized system requires relatively much more duration for the orthodontist to prepare. The customized bracket system necessitates several steps to set up a treatment plan, including modification by an orthodontist and a technician. Though, the extended planning time led to a better treatment outcome. The planning and preparation for treatment that is well-executed can reduce the amount of chairside time.

Customized orthodontic treatment systems are based upon digital models of the patient which can be obtained from accurate impressions or scans of the dental arches taken prior to the orthodontic treatment. In this bracket system tip/torque are being added to brackets for every patient for the specific corrections which greatly

reduces the requirements of detail bends in archwire and bracket re-bonding, which results in less traumatic mechanics, and improved treatment outcomes[1].

These brackets are tailored to the specific tooth shape of the individual patient. This provides the higher potential in reduction of treatment and chairside time, making orthodontic cases much more predictable, accurate, and efficient. It was a primary objective of this bracket system to provide a functional and practical manner for achieving clinically desired torque values using less than full-sized wires with consistent, accurate and predictable results.

II. Material And Methods

The study was carried out in a sample size of 14 patients. All patients above the 13 years of age were considered for the study. The study was carried out in The Department of Orthodontics, ITS Dental College, Greater Noida. The study group comprised patients with Bimaxillary protrusion**.**

Study Design: Prospective observational study

Study Location: The study was carried out in The Department of Orthodontics at ITS Dental College, Greater Noida.

Study Duration: November 2020 to December 2022.

Sample size: 14 patients.

Sample size calculation: The sample size was estimated on the basis of a single proportion design. The target population from which we selected our sample on the basis of inclusion and exclusion criteria. We assumed that the confidence interval of 10% and confidence level of 95%. The sample size actually obtained for this study was 7 patients for each group. We planned to include 14 patients (Group I- Conventional bracket system, Group II- Customized bracket system 7 patients for each group) with 0% drop out rate.

Subjects & selection method: The study population was drawn from OPD patients who presented to ITS Dental College and Hospital Greater Noida with Bimaxillary protrusion and were advised extraction of all four first premolar extraction. Patients were divided into two groups (each group had 7 patients). Group I- Conventional bracket system, Group II- Customized bracket system.

Inclusion criteria:

1. Bimaxillary malocclusion
2. Skeletal & dental Class I malocclusion
3. No history of Orthodontic treatment

Exclusion criteria:

1. Skeletal & dental class II malocclusion
2. Skeletal & dental class III malocclusion
3. Congenitally missing teeth
4. Peg lateral
5. Cleft lip/palate
6. Syndrome associated malocclusion

Procedure methodology

14patients with bimaxillary protrusion were selected on the basis of inclusion and exclusion criteria and after that pre- treatment records were taken. Impressions were made with polyvinyl siloxane material and then study models were prepared with ortho-kal. For group II patients study models were transferred to the lab. For group II tip and torque were analyzed on the models with torque analyzing device. Then on the basis of case torque and tip were added to the base of the brackets by TARG machine. Then transfer trays were fabricated with bio-plast sheet on the study model for indirect bonding. Indirect bonding was performed on group II patients and then cured.

Statistical analysis

The data for the present study was entered in the Microsoft Excel 2007 and analyzed using the SPSS statistical software 19.0 Version. The descriptive statistics included mean, standard deviation. The level of the significance for the present study was fixed at 5%. The intergroup comparison for the difference of mean scores

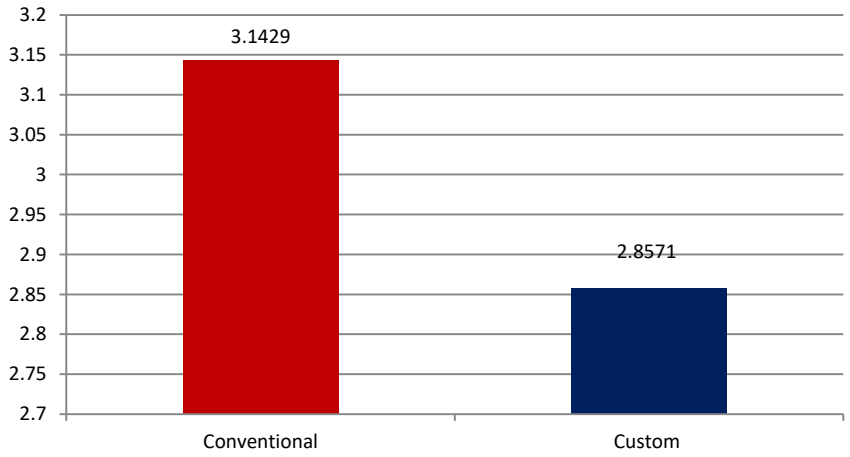
between two independent groups was done using the unpaired/independent t test. The Shapiro–Wilk test was used to investigate the distribution of the data and Levene's test to explore the homogeneity of the variables. The data were found to be homogeneous and normally distributed. Mean and standard deviation (SD) were computed for each variable.

III. Result

The study was carried out in a sample size of 14 patients. All patients above the 13 years of age were considered for the study. The study was carried out in The Department of Orthodontics, ITS Dental College, Greater Noida. The study group comprised patients with Bimaxillary protrusion**.**

Table no 1. Levelling and aligning (number of wires) between the Conventional and Customised bracket system.

	Mean	Std. Deviation	Std. Error Mean	T value	P value
Conventional	3.1429	.69007	.26082	0.775	0.454 (Sig)
Custom	2.8571	.69007	.26082		

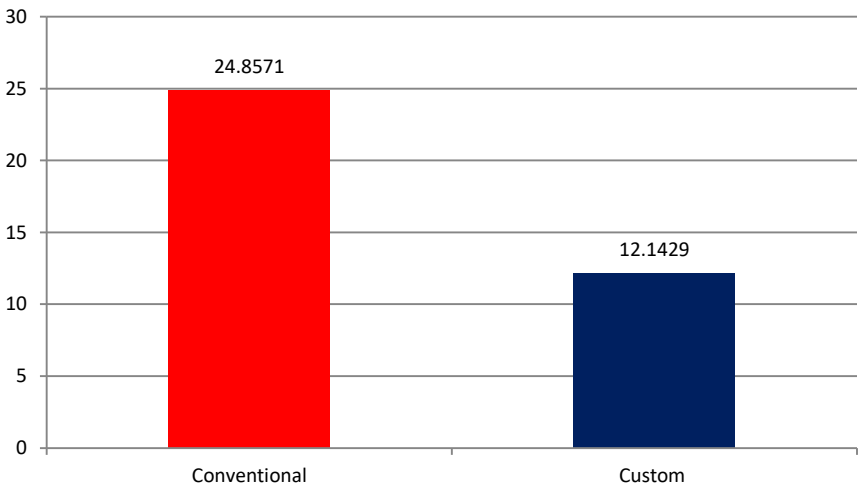


Independent t test at p value less than 0.05 is significant

The mean number of the wires required for the levelling and aligning was lesser in the customised group (3.142) as compared to the conventional group (2.857) (Table 1). The difference between the groups was statistically non-significant with p value of 0.454.

Table no2: Bonding duration between the conventional and customised bracket system

	Mean	Std. Deviation	Std. Error Mean	T value	P value
Conventional	24.8571	3.13202	1.18379	8.869	0.001 (Sig)
Custom	12.1429	2.26779	.85714		

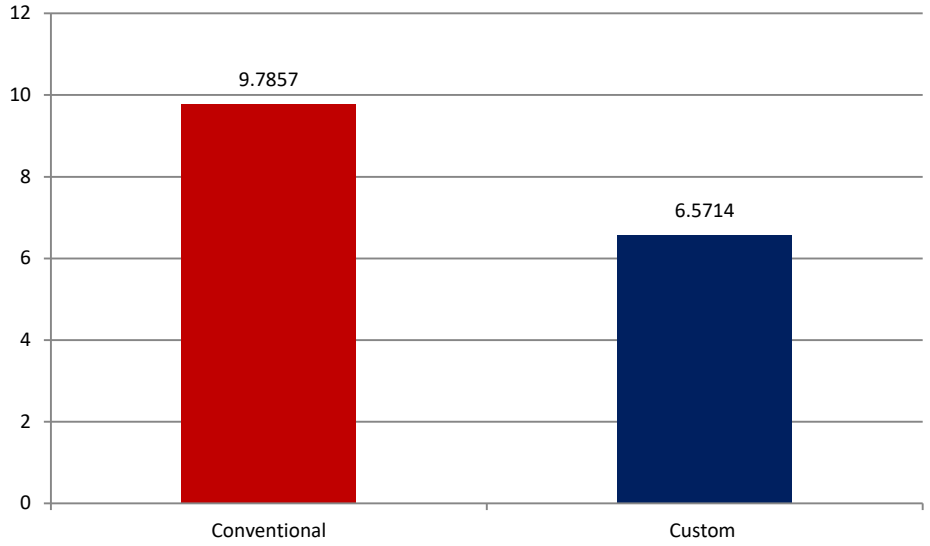


Independent t test at p value less than 0.05 is significant

The mean duration (minutes) of the bonding was lesser in the customised group (24.857) as compared to the conventional group (12.142) (Table 2). The difference between the groups was statistically significant with p value of 0.001

Table no 3 Duration of space closure between the Conventional and Customised bracket system.

	Mean	Std. Deviation	Std. Error Mean	T value	P value
Conventional	9.7857	.80917	.30584	8.405	0.001 (Sig)
Custom	6.5714	.60749	.22961		

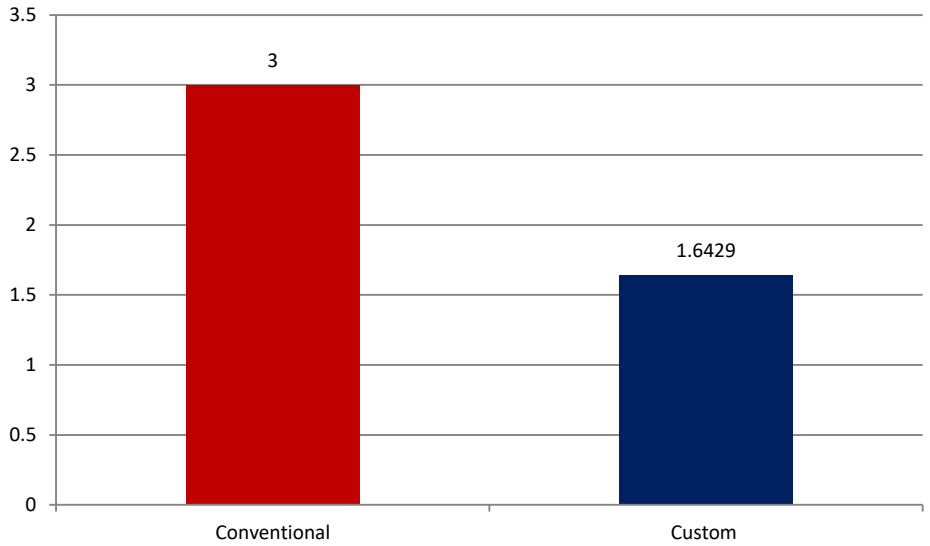


Independent t test at p value less than 0.05 is significant

The mean duration (months) of the space closure was lesser in the customised group (9.785) as compared to the conventional group (6.571) (Table 3). The difference between the groups was statistically significant with p value of 0.001.

Table. 4 Anchor loss between the Conventional and Customised bracket system

	Mean	Std. Deviation	Std. Error Mean	T value	P value
Conventional	3.0000	.64550	.24398	4.472	0.001 (Sig)
Custom	1.6429	.47559	.17976		



Independent t test at p value less than 0.05 is significant

The mean anchorage (measured in millimetre) loss was lesser in the customised group (3.000) as compared to the conventional group (1.642) (Table 4). The difference between the groups was statistically significant with p value of 0.001.

IV. Discussion

Customized brackets with patient-specific tip and torque, are among the most recent advancements in the specialty. In addition to precise and customised milling of orthodontic appliances, the use of 3D technology allows the practitioner to use virtual treatment planning software to better identify case objectives and visualise treatment outcomes.

In this study we evaluated leveling and aligning, duration of space closure, amount of anchor loss, the effect on chairside time, patient compliance and the difference in the treatment efficacy of conventional and customized labial bracket system in 14 patients (7 in customized and 7 in conventional group).

The patients that were selected for this study were subjects with permanent dentition and bimaxillary malocclusion, class I malocclusion and no history of orthodontic treatment. Subjects with skeletal class II, skeletal class III, congenitally missing teeth, peg lateral, cleft lip/palate, syndrome associated malocclusion were eliminated from the study.

In our study, the conventional group had a higher mean number of wires required for levelling and aligning (3.142) than the customised group (2.857). With a p value of 0.454, the difference between the groups was statistically insignificant (Table1). The results of this study were not in accordance with the study conducted by Dennis J Weber in 2013[2], who observed that customised bracket system creates a design of the final occlusion and alignment using reverse-engineered brackets used to obtain the intended result. In their study the bracket slots were customized to accommodate a straight wire that moves each tooth to the ideal final position, hence requiring lesser number of wires for levelling and aligning.

The results of the study were also not in accordance with the study conducted by Reukers in 1997[3], who observed substantial differences in the duration of levelling and aligning in a randomised controlled trial evaluating that conventional appliance required more auxiliaries and hence required more time than customised appliances.

The bonding in the conventional group was done by the direct bonding method while in customised group it was done by indirect bonding method. The results showed significant changes in the duration of bonding between the two. A longer mean bonding duration was observed in the conventional group (24.857) as compared with the customised group and the difference between these two groups was statistically significant (Table 2).

The results of this study were in accordance with the study conducted by Lincoln Issamu Nojima in 2015[4] who observed that even though indirect bonding needs more laboratory work and is more method sensitive, it is more precise and reduces chair side time.

Another study whose results were not in accordance with our study, was conducted by Li, Y, Mei, L in 2019[5], who observed that the direct and indirect bonding techniques had no significant difference in bracket placement accuracy, oral hygiene status and bond failure rate, for bonding orthodontic brackets. The indirect bonding might require less chairside time but more total working time in comparison with the direct bonding technique. However, the chairside time varies significantly.

The customised group had a higher number of debonded brackets, the reason for which could be attributed to its bulkier design of the base modified for incorporation of torque. The customized brackets were placed in a predetermined ideal position. Furthermore, the customised brackets were bonded indirectly, whereas the conventional brackets were bonded directly. Similarly, Menini et al. (2014)[6], conducted a longitudinal study in which patients were divided into two groups: Group A bonded with direct technique and Group B bonded with indirect technique. The results showed insignificant changes in the total bond failure rate between direct and indirect approaches and also between the upper and lower arches. The only significant difference was found when comparing the posterior region of the lower arches of both groups, where a greater number of brackets debonding was observed in group B, which was bonded using the indirect approach.

The bimaxillary protrusion cases were included in our study and first premolars were extracted in both the upper and lower dental arches. En-mass retraction was performed with active tie back and the duration of space closure was evaluated in both the conventional and customised bracket system groups. The mean duration (months) of the space closure was higher in the conventional group (9.785) as compared to the customised group (6.571) (Table 3). The difference between these two groups was statistically significant.

Clinically, the duration of extraction space closure was observed during en-mass retraction. In the customised bracket system group, the period of space closure was shortened to around 3 months. Hence the results are also significant clinically.

The results of this study were in accordance with our study conducted by Shoaib Ulla Khan et al. 2022[7], who divided the patients into two groups conventional and customised bracket system groups. The clinical

effectiveness and efficiency were assessed by estimating the initial and final Peer Assessment Rating (PAR) scores, assessing the total therapy time, number of scheduled appointments, number of examination visits, number of loose brackets, and pain rating during treatment, which was recorded using a numerical rating scale. They found significant difference in the overall treatment duration between the two groups.

Another study the results of which was in accordance with our study was conducted by Antonio Gracco et al. in 2013[8], where the authors presented clinical reports in which cases were treated with customised bracket system. they observed that the use of patient-specific brackets, indirect bonding transfer devices reduces treatment and chairside time, making orthodontic treatments more predictable, accurate, and efficient.

For both the group Transpalatal arch was source of anchorage and the loss of anchorage was analysed and measured with the help of cephalometric superimpositions. The mean anchorage loss was observed to be higher in the conventional group (3.000) as compared to the customised group (1.642) (Table 4). The difference between the two groups was statistically significant.

Shivanand Venkatesh in 2014[9], conducted a prospective study on customised lingual bracket system and conventional labial bracket system, the results of which were in accordance with our study. They concluded that the customised lingual bracket system provided better anchorage control than the conventional labial appliance during space closure.

The study has certain limitations, and the conclusions should be evaluated with these limitations in consideration. The sample size of patients was small and the same study can be done in a bigger sample.

Another possible limitation which came into frame was that the customised bracket system was highly expensive because brackets had to be customised according to individual patient's tip and torque values. It was a technique sensitive and a time taking process, which required multiple steps inside the laboratory. It necessitated highly skilled lab staff and facilities where these brackets could be customised with patient-specific values.

Nevertheless, the customized bracket system can be safely considered as one of those modifications which has reshaped the orthodontic practice and hence, improved the quality and efficacy of treatment. This bracket system allows orthodontists to provide high-quality treatment in less time and reduced chairside time.

V. Conclusion

The study was to evaluate and compare the effect on chairside time, the duration of space closure and anchor loss between the conventional and customized labial bracket system. This study incorporates clinical/Radiographic evaluation after leveling and aligning with both the bracket system, duration of space closure after the use of conventional and customized labial bracket system, amount of anchor loss was observed, check patient compliance with both bracket system, observed the difference in the treatment efficacy of conventional and customized labial bracket system.

The salient conclusions of this study are following:

1. The number of the wires, required for the levelling and alignment were insignificantly elevated in the conventional bracket system group when compared to the customised labial bracket system group.
2. The duration (months) of the space closure was lesser in customised labial bracket system group when compared with the conventional bracket system group.
3. The mean duration (minutes) of the bonding was greater in the conventional bracket system group when compared with the customised labial bracket system group.
4. The anchorage (measured in millimetre) loss was higher in the conventional bracket system group when compared with the customised labial bracket system group.
5. The duration of space closure and the amount of anchor loss, all these were significantly lesser in customised labial bracket system group.

   So, the efficacy of customised labial bracket system was significantly higher than the conventional bracket system.

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