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# A cross-sectional study on the analysis of periodontal parameters in adult patients with clear aligners orthodontics treatment versus three other types of brackets

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***Abstract*---**Objective: To analyse the gingival parameters in the orthodontic treatment using clear aligners versus the three other types of brackets, i.e., conventional metal, conventional ceramic, and metal self-ligating. Materials and methods: The current study comprised 80 individuals who came in for regular appointments and were receiving orthodontic treatment. They were then separated into four groups, each with 20 patients: Group 1 received traditional brackets (CB); Group 2 received traditional ceramic brackets (CCB);

Group 3 received self-ligating (SL) brackets; and Group 4 received clear aligner (CA) treatment. The inclusion criteria were any patient under the age of 18 with a Class II or Class III skeletal link who was receiving orthodontic treatment for at least 6 months with fixed orthodontic appliances (FOA) on their teeth. Smokers, pregnant women, diabetics, and those using medications that impact gingival health or who have cardiovascular illnesses were all excluded from the study. Patients who had used antiseptic solutions or mouthwash in the previous six months, had any periodontal procedures in the previous six months, or had fixed bridges and crowns or extensive restorations adjacent to the gingival borders were also excluded. For all groups, seven indices were recorded, including plaque index, gingival index, gingival bleeding index, sulcus bleeding index, papillary bleeding index, basic periodontal examination index, and bleeding on probing index. Results: Group 1 with CB had a mean age of 26.65 5.15 years, whereas Group 2 with CCB had a mean age of 27.65 8.15 years and Group 3 with SB had a mean age of 26.85 5.19 years. The average age of Group 4 with CA therapy was 26.85 4.83 years. The researchers used multivariate analysis and a Bonferroni correction (P = 0.008). When compared to the CB and CCB groups, CA therapy has better periodontal parameter values, however there is no significant difference with the SL brackets group. Conclusion: When compared to other forms of orthodontic treatments, such as CB and CCB brackets, CA therapy has higher periodontal indices; nevertheless, there is no significant difference with the SL brackets group. Oral hygiene guidelines should be followed before, during, and after the treatment.

***Keywords*---**Clear aligners, conventional braces, fixed appliances, periodontal indices, plaque, self-ligating.

## Introduction

The goal of orthodontic treatment is to improve the aesthetics and look of the patient's smile, which is the primary motivator for those who are considering it. [1] However, orthodontic therapy is reliant on the use of fixed brackets, metal wires, and other components, which results in a time-consuming teeth cleaning. Due to the huge areas covered by the braces, maintaining adequate oral hygiene might be difficult at times. [2] The orthodontic appliance itself develops plaque-retentive regions, which, when combined with poor dental hygiene, exacerbates periodontal disease and promotes tissue loss. [2]

As a result, malocclusion has a direct impact on periodontal health by contributing to plaque accumulation. Gingival tissue and the attachment apparatus are simulated by proper occlusion and masticatory functions. When the occlusion function is poor, the odds of plaque retention and calculus formation are significant, making the patient more susceptible to gingival inflammations and dental caries, particularly cervical caries. Once gingival inflammation and dental cavities have established in, bone loss supporting the

functional teeth and periodontal membrane constriction may occur because orthodontic treatments often require generating bone turnover to move the tooth within the bone, supportive tissue such as bone and ligaments play a crucial role in tooth movement during orthodontic therapy. Gingival health is one of the most essential factors influencing the success rate of any orthodontic treatment; it's critical to keep the patient's oral health in good shape to avoid inflammation and periodontal damage to the gingiva and supporting tissue.Plaque in the oral cavity causes an alterationin bacterial shift. The proliferation of suspected periodontal pathogens characterises qualitative changes in the microbiota. [3] According to several research, orthodontic appliance attachment causes a shift in the subgingival microbial composition, which increases the risk of periodontal disease. [4] Plaque is a biofilm made up of bacterial aggregates that adheres to the teeth and provides nutrients as well as protection from the host's defences, creating a stable environment. [5,6] Streptococci and/or Actinomyces account for 90% of plaque cells. [7]

Depending on the type of surface and its ability to hold microorganisms, plaque accumulation comprises bacteria on the surface of the tooth induced by electrostatic interactions and Van der Waals forces. [8,9] The presence of S. mutants and Lactobacilli in orthodontic patients has been linked to an increased risk of colonisation by S. mutants and Lactobacilli,[10] which can lead to periodontal disease or loss of supporting tissue surrounding the moving teeth, resulting in orthodontic treatment failure.

Side effects such as qualitative bacterial shift, which is linked to gingivitis and a rise in pocket depth as well as the BOP index, further impede orthodontic treatment. Different bracket types have different physical and clinical features, which affect the amount of biofilm deposition on orthodontic device components and, as a result, the production of gingivitis and plaque. To secure the metal wire inside the bracket's slot, conventional brackets are combined with various components such as elastomeric and metal ligatures. Self-ligating brackets, on the other hand, are orthodontic brackets that can open and shut the wire slot without the use of an additional elastomeric or metal ligature to clasp the wire inside the braces slot.

Plaque buildup is more common with traditional brackets, and periodontal cleaning and oral hygiene are more difficult. (11-13) To alleviate the shortcomings of the traditional brackets, some manufacturers and researchers suggested changing them into self-ligating brackets. 14-16 Because of their unique shape and lack of metal ligatures and elastomeric, self-ligating brackets, according to those manufacturers, are less prone to bacterial shift alterations. [17] In 1999, a novel technology in orthodontic treatment was introduced, demonstrating the ability of a removable device to gradually reposition teeth based on a computerised treatment plan. [18]

By doing away with areas of more plaque accumulation, this type of treatment significantly reduced the side effects of both self-ligating and conventional brackets. However, it has to be seen whether microbe adhesion and plaque shift are reduced enough in self-ligating brackets to offer the orthodontic practitioner confidence to treat patients with a low number of periodontal disorders. It is

important to note that clear aligner treatment is not appropriate for all types of orthodontic treatment, leading dentists to return to the use of CB and SL brackets. In this region, there is a lack of data on periodontal status in orthodontic patients. The goal of this study is to use clinical assessment of seven gingival parameters to estimate the gingival status of orthodontic patients with various types of brackets and clear aligner therapy.

**Materials and Methods**

During December 2015 to February 2016, a cross sectional research of patients undergoing active orthodontics treatment of various types (CB, SL, CA, CCB) from various facilities was conducted. To avoid bias in our study, we chose an equal number of participants from each gender. The study involved 80 patients, with 40 males and 40 females. Patients were divided into four categories:

- Group I: 20 patients (13 men, 7 women) with a mean age of 26.6 ±5.15 years were managed with metal traditional edgewise brackets (Equilibrium 2, Dentaurum, Inspringen, Germany) ligated with a stainless steel wire.
- Group II: Twenty participants (9 males, 11 females) with an average age of 27.65 ± 8.15 years were treated with ceramic traditional brackets (Damon Clear smile, USA)
- Group III: self-ligating brackets were used on 20 patients (10 males, 10 females) with an average age of 26.85 ± 5.19 years (TomyInt Inc., Japan)
- Group IV: 20 patients (8 males, 12 females) with an average age of 26.85 ± 4.83 years who were treated with clear aligners (Angle Align, China/Invisalign, USA). The following factors were used to screen and select patients: Any patient under the age of 18 who has a Class II or Class III skeletal connection and is undergoing orthodontic treatment with fixed orthodontic appliances (FOA) on both arches for at least 6 months is eligible to participate.

**Exclusion**

Those who were smokers, pregnant, diabetics, or using medication that affected gingival health or had cardiovascular disease were excluded from the study. Patients who had used antiseptic solutions or mouthwash in the previous six months, had any periodontal procedures in the previous six months, or had fixed bridges and crowns or extensive restorations adjacent to the gingival borders were also excluded. The study's purpose was explained to the patients, along with the prospect of using anonymous data for study purposes. Patients were satisfied because they received straightforward answers to any questions they had. Prior to their clinical examination, participants were given a consent form to sign, and they were only asked to sign it if they agreed to participate in the study.

For patients who came in for regular appointments, clinical examinations were conducted in various hospitals. To predict periodontal health in all groups in our study, we employed the following seven periodontal indices: Silness and Loe published the Plaque Index (PI) in 1964. 2. The gingival index is a measure of how healthy your teeth are (GI) Carter and Barnes' 3. Gingival Bleeding Index (GBI) (1974) 4. Muhlemann and Son's Sulcus Bleeding Index (SBI), 1971 The Papillary

Bleeding Index (PBI) is a measure of how (PBI) 6. BPE index (basic periodontal examination) 7. The BOP (bleeding on probing) index.
All indices were collected using special periodontal charts designed especially for the research. One calibrated examiner carried out all clinical assessments.

**Statistical analysis**

For data analysis, we utilised the statistical Package for Social Sciences (SPSS 22.0, Chicago, IL, USA). Frequencies, mean, and standard deviation were calculated using descriptive analysis. The researchers used multivariate analysis and a Bonferroni correction (P value = 0.008).

**Results**

Over the course of trial, a total of 80 patients, 40 men and 40 women, with a mean age of 27 years ± 5.88 were enrolled. hey were sorted into four groups after some participants were excluded. Metal conventional brackets (Equilibrium2, Dentaurum, Inspringen, Germany) ligated with a stainless steel wire were used on the first treatment group, which included 13 males and 7 females with a mean age of26.65 ± 5.15 years.

The second group included 9 males and 11 females with a mean age of 27.65 ± 8.15 years who were treated with ceramic traditional brackets (Damon Clear smile, USA/3M clarity, USA). The third group consisted of 10 males and 10 females with an average age of 26.8 ±5.19 years who were treated with self-ligating brackets (Tomy International Inc., Japan), whereas the fourth group consisted of 8 males and 12 females with an average age of 26.85±4.83 years who were treated with clear aligner treatment (Angle Align, China/Invisalign) [Table 1].

Table 1
Age group and gender distribution of the four groups

| Group | Group/age | Male | Female | Total name |
|---|---|---|---|---|
| Group1 | *n* | 13 | 7 | 20 |
| | Age(years) | 25.3±3.8 | 29.1±6.6 | 26.6±5.1 |
| Group2 | *n* | 9 | 11 | 20 |
| | Age | 28.1±7.4 | 27.2±9.0 | 27.6±8.1 |
| Group3 | *n* | 10 | 10 | 20 |
| | Age | 28.5±3.0 | 25.2±6.5 | 26.8±5.1 |
| Group4 | *n* | 8 | 12 | 20 |
| | Age | 27.6±5.2 | 26.3±4.7 | 26.8±4.8 |
| Total | *n* | 40 | 40 | 80 |

**Plaque index**

The first group's mean PI was 1.7, the second group's was 1.6, the third group's was 1.5, and the fourth group's was 0.2 [Table 2]. A significant difference existed between groups 1 and 4 (P value = 0.00), groups 2 and 4 (P value = 0.00), and groups 3 and 4 (P value = 0.00). However, there was no statistical difference

between groups 1 and 2 (P value = 0.19), 1 and 3 (P value = 0.03), or 2 and 3 (P value = 0.38).

**Gingival index**

The first group's mean GI was 1.26; the second group's was 0.85; the third group's was 0.76; and the fourth group's was 0.008 [Table 2]. Between groups 1 and 3 (P value = 0.00), groups 1 and 4 (P value = 0.00), groups 2 and 4 (P value = 0.00), and groups 3 and 4 (P value = 0. 00), there was a significant difference. The difference between groups 1 and 2 (P value = 0.01) and groups 2 and 3 (P value = 0.560) was not significant. Index of gingival bleeding The first group's mean GBI was 11.25; the second group's was 4.2; the third group's was 0.7; and the fourth group's was 0.00 [Table 2].

Table 2
Periodontal indices and differences of P value of the four groups

| Indices | Group | *n* | Mean | SD | 1vs2 | 1vs3 | 1vs4 | 2vs3 | 2vs4 | 3vs4 |
|---|---|---|---|---|---|---|---|---|---|---|
| PI | 1 | 20 | 1.71 | 0.36215 | 0.198 | 0.033 | 0.000 | 0.38 | 0.000 | 0.000 |
| | 2 | 20 | 1.56 | 0.49 | | | | | | |
| | 3 | 20 | 1.46 | 0.33 | | | | | | |
| | 4 | 20 | 0.20 | 0.18 | | | | | | |
| | Total | 80 | 1.23 | 0.70 | | | | | | |
| GI | 1 | 20 | 1.26 | 0.67 | 0.01 | 0.002 | 0.000 | 0.560 | 0.000 | 0.000 |
| | 2 | 20 | 0.8541 | 0.49963 | | | | | | |
| | 3 | 20 | 0.7642 | 0.48007 | | | | | | |
| | 4 | 20 | 0.01 | 0.02 | | | | | | |
| | Total | 80 | 0.72 | 0.65 | | | | | | |
| GBI | 1 | 20 | 11.2 | 2.76 | 0.00 | 0.0 | 0.0 | 0.0 | 0.000 | 0.370 |
| | 2 | 20 | 4.20 | 3.88 | | | | | | |
| | 3 | 20 | 0.70 | 1.12 | | | | | | |
| | 4 | 20 | 0.00 | 0.01 | | | | | | |
| | Total | 80 | 4.03 | 5.09 | | | | | | |
| SBI | 1 | 20 | 1.91 | 0.68 | 0.004 | 0.0 | 0.00 | 0.0 | 0.000 | 0.018 |
| | 2 | 20 | 1.31 | 0.93 | | | | | | |
| | 3 | 20 | 0.49 | 0.53 | | | | | | |
| | 4 | 20 | 0.005 | 0.02 | | | | | | |
| | Total | 80 | 0.93 | 0.97 | | | | | | |
| PBI | 1 | 20 | 1.63 | 0.72 | 0.01 | 0.0 | 0.0 | 0.02 | 0.000 | 0.015 |
| | 2 | 20 | 1.15 | 0.88115 | | | | | | |
| | 3 | 20 | 0.50 | 0.56 | | | | | | |
| | 4 | 20 | 0.00 | 0.02 | | | | | | |
| | Total | 80 | 0.82 | 0.88 | | | | | | |
| PDI | 1 | 20 | 2.20 | 0.56 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.339 |
| | 2 | 20 | 1.08 | 0.64 | | | | | | |
| | 3 | 20 | 0.13 | 0.14 | | | | | | |
| | 4 | 20 | 0.00 | 0.01 | | | | | | |
| | Total | 80 | 0.85 | 0.98 | | | | | | |
| BOP | 1 | 20 | 0.70 | 0.09 | 0.193 | 0.825 | 0.704 | 0.129 | 0.094 | 0.873 |
| | 2 | 20 | 3.09 | 11.5 | | | | | | |
| | 3 | 20 | 0.30 | 0.10 | | | | | | |
| | 4 | 20 | 0.01 | 0.01 | | | | | | |
| | Total | 80 | 1.02 | 5.77 | | | | | | |

**Sulcus bleeding index**

The first group's mean SBI was 1.91, the second group's was 1.32, the third group's was 0.49, and the fourth group's was 0.005 [Table 2]. Between groups 1 and 3 (P value = 0.00), groups 1 and 4 (P value = 0.00), and groups 2 and 4 (P value = 0.00), there was a significant difference (P value = 0.00). There was no significant difference between groups 1 and 2 (P value = 0.004), 2 and 3 (P value = 0.00), or 3 and 4 (P value = 0.018). The Papillary Bleeding Index is a measurement of how much blood The first group's mean PBI was 1.63, the second group's was 1.15, the third group's was 0.5, and the fourth group's was 0.0051 [Table 2].

Between groups 1 and 2 (P value = 0.019), groups 1 and 3 (P value = 0.00), groups 2 and 4 (P value = 0.00), and groups 1 and 4 (P value = 0.00), there was a statistical difference. Between groups 2 and 3 (P value = 0.002) and groups 3 and 4 (P value = 0.015), there was no statistical difference. [Graphic 6]. Periodontal examination index (basic) The first group's mean BPE index was 2.2, the second group's was 1.08, the third group's was 0.14, and the fourth group's was 0.007 [Table 2].

Between groups 1 and 2 (P value=0.000), groups 1 and 3 (P value=0.00), groups 1 and 4 (P value = 0.00), groups 2 and 3 (P value = 0.00), and groups 2 and 4 (P value < 0.001), there was a statistical difference. There was no statistically significant difference between groups 3 and 4 (P value = 0.34). On probing index, there is bleeding. The first group's mean BOP index was 0.71, the second group's was 0.1, the third group's was 0.30, and the fourth group's was 0.01 [Table 2]. The difference between groups 1 and 2 was not significant (P value = 0.19).

**Discussion**

Conventional brackets (CB) cause issues in terms of plaque buildup and retention. [19,20] During orthodontic treatment, patients with CB demonstrated an increased amount of plaque accumulation and poor oral hygiene, according to a research. [21,22] Plastics and bonding materials, which act as the retention site, have been shown to have negative impacts on gingival health in other research. [23] Increased plaque levels cause enamel demineralization, which appears as white patches, as well as increased caries and gingival tissue inflammation. In traditional orthodontic patients, the presence of metal ligation wires contributes to the formation of tooth plaque. [24]

The data in our investigation revealed that the PI level in the CB group was higher than the other groups. The difference between the CB, CCB, and CA groups was considerable. We concluded that plaque levels were significantly lower in CA patients than in CB patients. In our data, we determined that the CA group displays better levels in all 7 indices measured, which could be explained by the ease of access and better dental hygiene. Our findings are comparable to those reported in a 2015 study.[25]

The study also found a significant difference in PI and GI between the CA and SL groups, with the SL treatment leading to better oral hygiene, which is explained

by the SL method requiring fewer modules to retain the brackets, as well as less angels and wings. Pellegrini et al. published a study in 2009 with similar findings.[26] In either of our groups, the BOP showed no change, which could be explained by patient adherence to hygiene guidelines.
Our CA group had higher indices, which resulted in better oral and gingival health during the treatment time, as well as better cosmetically and functionally. In a recent study, CA treatment was found to have a higher degree of periodontal health indices than CB treatment. [27] Our CB group had a higher BPE score, and the CCB group had a substantial difference from the CB. It was likewise higher in the SL group than in the CCB group, with a statistically significant difference.

There was no significant difference between the CA and the SL groups, which might be explained by the SL indices being lower than the CB groups, as well as the fact that SL brackets are smaller and require less accessories than the CB, resulting in CA having fewer and similar indices. We also discovered that the majority of our female patients preferred CA therapy since it allows them to maintain an attractive smile during treatment, which is not possible with metal brackets.

Despite the fact that our patients with CB appliances had poorer periodontal indices, CB remains a viable choice because CA cannot fix all orthodontic issues. Our research demonstrates the importance of following oral hygiene instructions and maintaining good periodontal health during orthodontic treatment in order to get better results. This is the first study that we know of that uses the BPE index to evaluate periodontal health in orthodontic patients. Because this is the first study to compare CA periodontal health to other orthodontic treatment options in this location, we encourage more research comparing CA periodontal health to other orthodontic treatment options. However, because of the higher cost of CA therapy, one of the study's drawbacks is that the number of patients with CA is lower.

## Conclusion

The clear aligners treatment showed better periodontal indices levels (PI, GI, GBI, SBI, PBI, BPE, BOP) when compared to the same levels in the conventional brackets, and in the case of self-ligating brackets, it shows no significant difference when compared to clear aligners, implying that self-ligating brackets are better than other types of brackets and less than clear aligners in numbers but not significantly, due to the less accessories and modules(o-ties –ligature etc).Clear aligners are advised as this therapy eases the oral hygiene procedures and leads to better oral hygiene. Its smaller sized brackets and the absence of wings and pointed angels prevent the buildup of food compared to conventional brackets, which leads to better periodontal indices.

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**Conflicts of interest**
There are no conflicts of interest.

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