

Effect of Bracket Size on Microbial Colonization & Periodontal Status During Early Phase of Orthodontic Treatment

Sharanya Sunketa^{1*} Seena Naik Eslavath² Thirumal Naik Mood³ Santosh Reddy Banswada⁴ Divya Perumallapalli⁵

¹PG Student, Department of Orthodontics, Meghna Institute of Dental Sciences, Nizamabad, Telangana, India.

²Professor and Head, Department of Orthodontics, Meghna Institute of Dental Sciences, Nizamabad, Telangana, India.

³Professor, Department of Orthodontics, Meghna Institute of Dental Sciences, Nizamabad, Telangana, India.

⁴Reader, Department of Orthodontics, Meghna Institute of Dental Sciences, Nizamabad, Telangana, India.

⁵Senior Lecturer, Department of Orthodontics, Meghna Institute of Dental Sciences, Nizamabad, Telangana, India.

ABSTRACT

Background: Dental plaque is defined clinically as a structured, resilient, yellow- grayish substance that adheres tenaciously to the intraoral hard surfaces, including removable & fixed restorations.

Materials and methods: 48 patients between age of 14 – 20 years were scheduled for fixed orthodontic treatment with MBT 0.022 slot. Patients inclusion and exclusion criteria was differentiated based on various parameters. Two groups with random allocation of bracket type as Mini conventional and Standard conventional. 24 patients were included in each group with 8 patients included in each subgroup. Microbial and periodontal records were obtained on the day of bonding (T₀) and 1 month after bonding (T₁).

Results: Standard brackets showed high values for colony count of both S mutans, lactobacillus and periodontal parameters than mini brackets from all the manufacturers.

Conclusion: The size of the bracket increases, the inter bracket distance decreased hindering with proper oral hygiene maintenance leading to increase in plaque accumulation and microbial colonization.

Keywords: Stuart transport medium, Mutans sanguis agar, Rogosa SL agar, Anaerobic gas jar, Incubator.

INTRODUCTION

Bacterial plaque at gingival margin is the most important etiological factor for the onset of gingival inflammation. Fixed orthodontic appliances with brackets and ligation create new areas of retention for plaque. Plaque accumulation around the brackets is one of the most common result of poor oral hygiene in children undergoing orthodontic treatment¹. Human mouth is an inhabitant of various micro organisms. They include both aerobic and anaerobic bacteria. The mouth presents various micro environments which may be colonized by various micro organisms².

The development of dental plaque has been associated with several environmental and individual factors including, diet composition, oral hygiene, fluoride exposure, the quantity of saliva, the composition of oral micro flora and immune factors³.

In addition to poor oral hygiene, local factors like malaligned dentition, faulty restorations, removable orthodontic/prosthetic appliances, fixed crowns, orthodontic bands further favor more plaque accumulation⁴.

Patients undergoing fixed orthodontic therapy have elevated levels of periodontal pathogens such as Streptococcus mutans (S.mutans), Actinobacillus

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*Correspondence Dr. Sharanya Sunketa.

Department of Orthodontics, Meghna Institute of Dental Sciences, Nizamabad, Telangana, India.

Email: sharanyasunketa@gmail.com



Fig 1a: Strap up (Dentaurum mini brackets).



Fig 1b: 1st visit after bonding (Dentaurum mini brackets).



Fig 2a: Strap up (Dentaurum standard brackets).



Fig 2b: 1st visit after bonding (Dentaurum standard brackets).

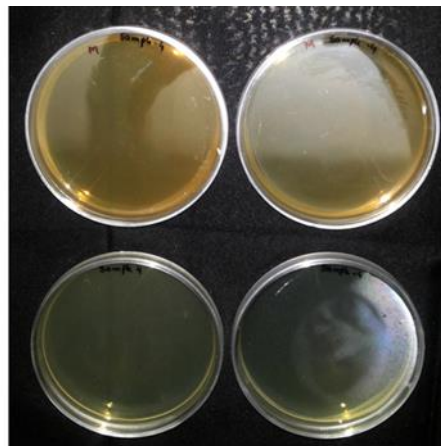


Fig 3: Media poured into petriplates.



Fig 4: Incubator with Petriplates in place for incubation 48 hrs at 37°C.

Dentaurum standard group After incubation in incubator for 48 hrs at 37°C

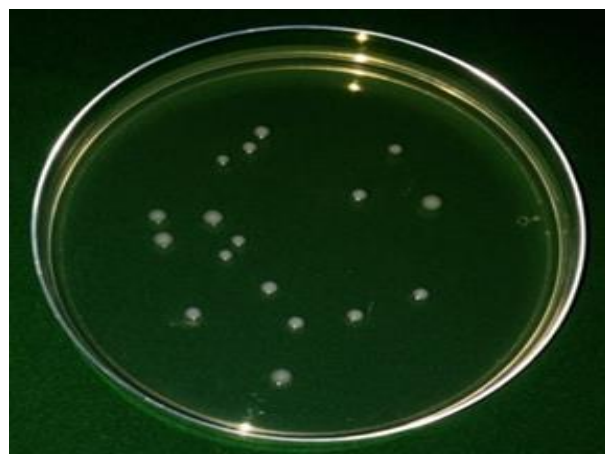


Fig 5a: Growth of streptococcus mutans at T0 under anaerobic conditions.

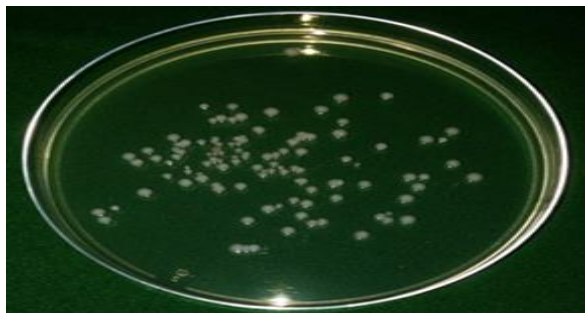


Fig 5b: Growth of streptococcus mutans at T1 under anaerobic conditions.



Fig 5c: Growth of Lactobacillus at T0 under aerobic conditions.

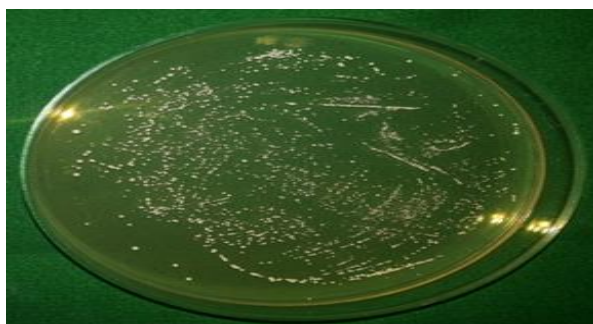


Fig 5d: Growth of Lactobacillus at T1 under aerobic conditions.



Fig 5e: Growth of Lactobacillus at T0 under anaerobic conditions.



Fig 5f: Growth of Lactobacillus at T1 under anaerobic conditions.

actinomycetemcomitans and Tannerella forsythia. Undisturbed supra gingival plaque initiates gingival inflammation called gingivitis and further leads to gingival hyperplasia. Porphyromonas gingivalis and Prevotella intermedia species were found in pre pubertal patients with Periodontitis. Type, design of brackets⁷, method of ligation and surface characteristics of composite have effect on microbiological profile of patients in oral environment.

Orthodontic brackets are made from metal, plastic and ceramic materials. Among these bracket materials stainless steel has highest critical surface tension. Thus, they have higher plaque retaining capacity when compared to plastic and ceramic brackets^{5,8}. Self-ligating appliances are introduced to reduce the frictional resistance, reduce the number of appointments and reduce chair side time of the operator by eliminating the process of ligation and have decreased the retention sites for microbial colonization. Thus, improved or improving the oral hygiene of the patient⁹. Recently manufacturers are supplying mini sized brackets with low profile, to improve the oral hygiene of the patients as they are easy to clean because of reduced size of brackets compared to the standard size available regularly. The smaller size of bracket also reduces the discomfort to the patient in the mouth.

The aim of the present study was to evaluate and compare the effect of size of the orthodontic brackets on microbial colonization & periodontal status during early phase of orthodontic treatment received from various manufacturers.

MATERIALS AND METHODS

The study population composed of 48 patients between age of 14 – 20 years scheduled for fixed orthodontic treatment.

Patients were included based on the following criteria:

- 1) Permanent dentition with good general health.
- 2) Mild to moderate crowding of the teeth.
- 3) Free of dental plaque, with absence of periodontal diseases such as gingival inflammation.
- 4) Motivation to maintain good oral hygiene.
- 5) No history of previous orthodontic treatment.
- 6) Absence of active carious lesions.
- 7) No otolaryngologic / systemic problems.
- 8) No signs of food lodgment between the teeth.

Individuals who had used antibiotics & oral mouth rinses during the past three month period will be excluded from the study, Patients with systemic illness and Patients in mixed dentition period were excluded from the study.

Patients were asked not to use any other oral hygiene supplements during the study except for tooth brushing. Oral hygiene instructions were given to all the patients at the beginning of the treatment. The study sample were divided into two groups with random allocation of bracket type as follows

Group 1: Mini conventional

Group 2: Standard conventional

Each group were further subdivided into 3 subgroups each, based on manufacturing company i.e. Dentaurum group, Leone group, Centrino group.

24 patients were included in each group with 8 patients included in each subgroup. All the bracket kits used for the study are of MBT .022 slot.

Microbial and periodontal records were obtained on the day of bonding (T_0) and 1 month after bonding (T_1), which is the time for the appointment to change the first arch wires by the same orthodontist.

Amount of Microbial colonization:

Microbial samples were taken from buccal surfaces of all bonded teeth, by running the explorer along gingival margin. The plaque sample was placed in 4ml of Stuart transport medium. After which the transport medium containing sample was then sent to microbiologist for culture and analysis. Serial 10 – fold dilutions of transport medium with the sample of plaque were prepared as 10^{-4} and 0.1ml samples were spread plated onto Mutans Sanguis agar medium (HiMedia laboratories). These agar plates were incubated for 48 hrs at 37°C in anaerobic jars. Subsequently, colonies formed on petriplates were counted using colony counting pen.

In addition a serial - 10 fold dilutions of sample was done till 10^{-3} dilution and 0.1ml samples and were inoculated on two Rogosa agar plates for colonization of lactobacillus. Both plates were incubated for 48 hrs at 37°C , one plate in aerobic conditions and other in anaerobic jar. The number of colonies formed on petriplates were counted using colony counting pen.

Periodontal measurements:

A complete periodontal examination was performed by means of Williams probe. Periodontal examination included gingival index (GI), plaque index (PI), and gingival bleeding index (GBI).

Periodontal indices were calculated as sum of mean scores by each examined tooth divided by number of evaluated teeth. A mean of all measurements for each patient was considered to assess the oral hygiene of the patient.

Statistical analysis: Results were statistically analyzed by using SPSS (version 16.0). Paired T Test was done to compare the variables at T_0 and T_1 . One-way ANOVA were done to compare change in the scores of microbial colonization and periodontal measurements at T_0 and T_1 between the groups. Parameters with $P < .05$ were considered statistically significant.

RESULTS

Table 1: Group-wise mean age distribution.

	N	Minimum	Maximum	Mean	Std. Deviation
Dentaurum Mini	8	7.00	23.00	15.1250	5.38351
Dentaurum Standard	8	17.00	35.00	26.1250	6.89591
Leone Mini	8	13.00	27.00	18.7500	5.06388
Leone Standard	8	6.00	42.00	27.7500	11.79285
Centrino Mini	8	13.00	31.00	20.0000	6.00000
Centrino Standard	8	14.00	51.00	30.1250	12.72161

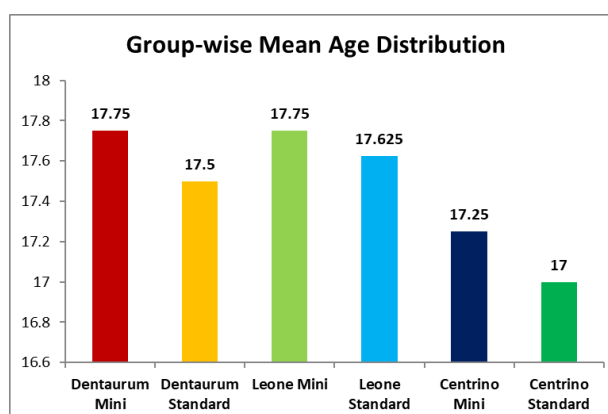
Table 2: Colony count in mutans agar plate under anaerobic conditions at baseline (T₀).

	N	Minimum	Maximum	Mean	Std. Deviation
Dentaurum Mini	8	14.00	20.00	17.7500	2.05287
Dentaurum Standard	8	14.00	20.00	17.5000	2.39046
Leone Mini	8	14.00	20.00	17.7500	2.05287
Leone Standard	8	14.00	20.00	17.6250	2.19984
Centrino Mini	8	14.00	20.00	17.2500	1.98206
Centrino Standard	8	14.00	20.00	17.0000	1.92725

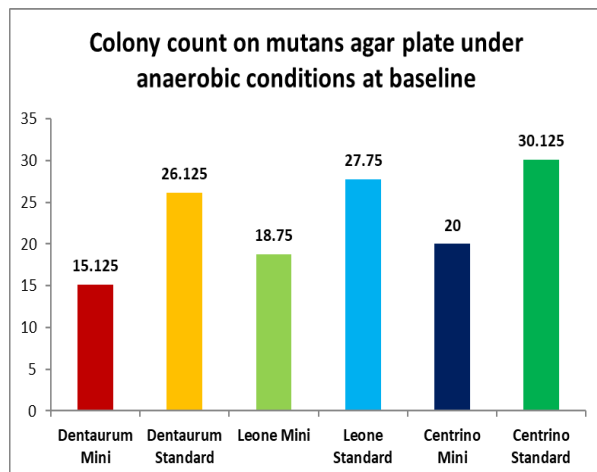
Microbial colony count measurements showed higher values for standard brackets than mini brackets at T₀ and T₁. Intra group comparison showed statistically insignificant colony count values of S mutans and Lactobacillus at T₀ and T₁.

Periodontal measurements:

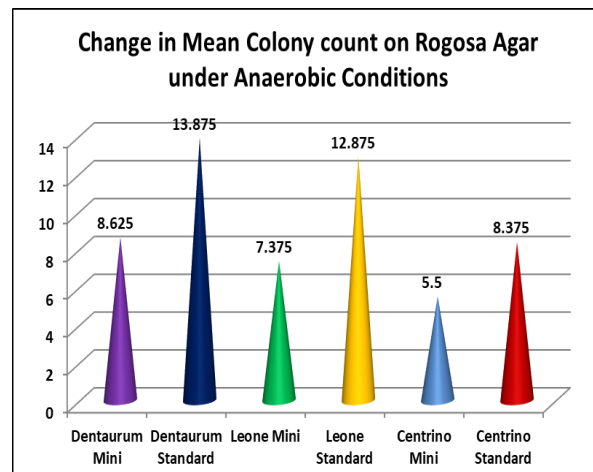
Periodontal parameters were increased significantly in all groups ($P < .05$) from T₀ to T₁. Though GI, PI and GBI measurements showed higher values for standard brackets than mini brackets. Inter group comparisons of GI, PI and GBI showed insignificant differences at any particular point of time ($P > .05$).



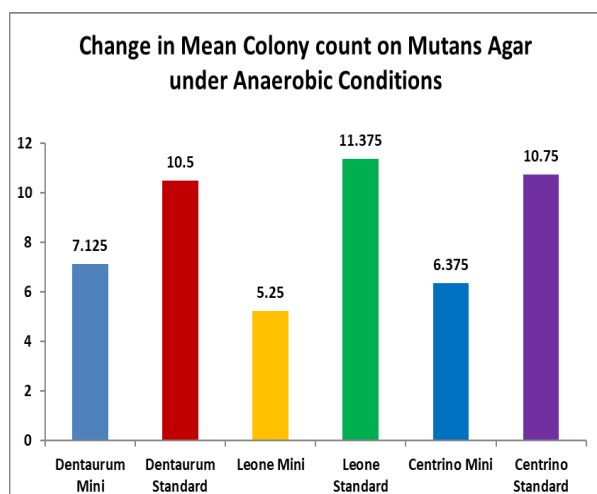
Graph 1: Group-wise mean age distribution.



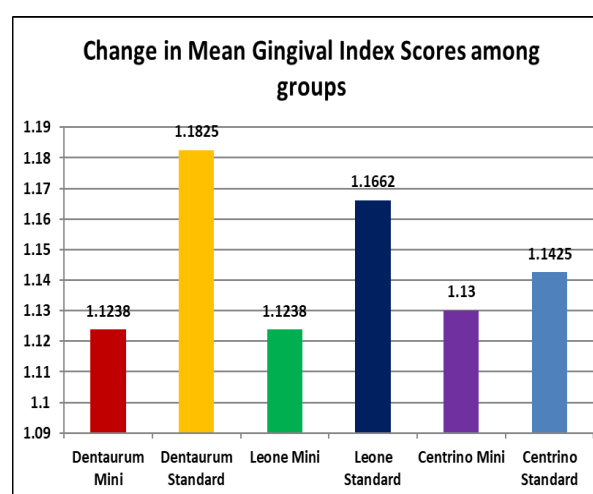
Graph 2: Colony count of S mutans under anaerobic conditions at T₀.



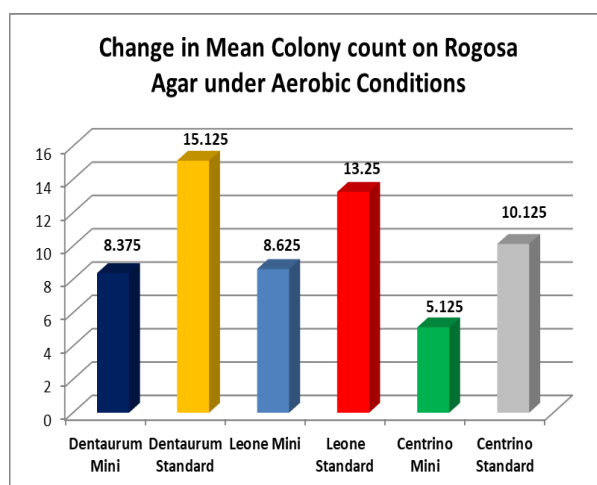
Graph 5: Change in mean colony count of Lactobacillus under anaerobic conditions.



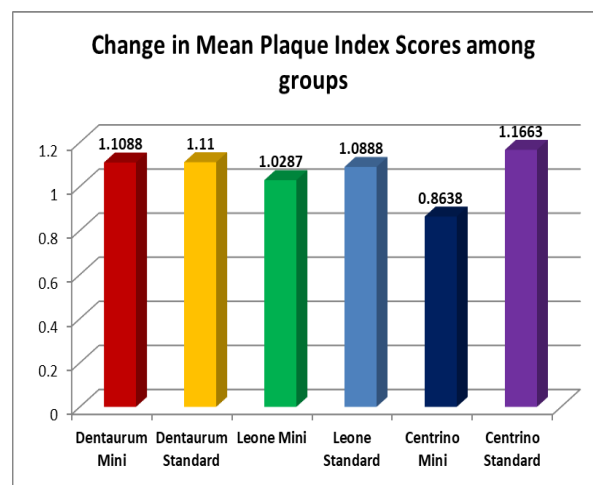
Graph 3: Colony count of S mutans under anaerobic conditions at T₁.



Graph 6: Change in mean Gingival index scores among groups.



Graph 4: Colony count of Lactobacillus under aerobic conditions at T₁.



Graph 7: Change in mean Plaque index scores among groups.

DISCUSSION

Fixed orthodontic appliances increase the bacterial plaque accumulation as they impede the oral hygiene by creating additional retentive sites for microbial colonization. Increased plaque accumulation causes gingival inflammation, halitosis, enamel demineralization which further causes white spot lesions and caries.

Forsberg et al.¹³ studied the contribution of the type of ligation technique on bacterial count and reported that elastomeric ties showed more affinity for bacteria than stainless steel ligatures. Van Gastel et al.¹⁵ concluded that bracket design had significant impact on bacterial accumulation and periodontal status. SLB's reduce the bacterial load as they eliminate the process of ligation on the contrary results suggest that the additional opening and closing mechanism further increase the retention sites for plaque.

Though time consuming, stainless steel ligatures are used in the present study to eliminate the method and material of ligation as a factor to influence on the clinical parameters. The effect of bracket size on microbial and periodontal status was compared in the present study, as there is no previous study comparing effect of mini and standard brackets on microbial and periodontal status in the literature.

Amount of microbial colonization:

In the present study, the colony count values of both *S.mutans* in anaerobic conditions and *Lactobacillus* in aerobic and anaerobic conditions showed statistically significant increase from T₀ to T₁. Our results were consistent with Rosenbloom et al.¹² study which has shown increase in levels of microorganisms during orthodontic treatment, but they suggested that it doesn't result in any long term elevation of *S.mutans*.

The colony count values of both *S.mutans* and *Lactobacillus* showed higher values for standard brackets from all the manufacturers when compared to mini brackets. The variation in colony count seen might probably because of the difference in size of the bracket. As standard brackets have more surface area compared to mini brackets but the difference was not statistically significant.

The results of our study were similar to the study done by Pandis et al.¹⁰ in which he stated that SLB's favored more accumulation of *S.mutans* compared to conventional brackets as the SLB's have more surface area due to the additional opening and closing mechanism, thereby increasing the microbial accumulation around the brackets. However the results stated that there was no statistical significance between both the groups. In contrast to the present study results Pejda et al.¹⁴ stated that bracket design didn't influence the amount of microbial accumulation and there was no statistical significant difference between SLB's and conventional brackets.

This was supported by Nalcaci et al.¹⁶ who has also reported that there was no statistical difference in microbial colonization of *S.mutans* and *Lactobacillus* in between SLB's and conventional brackets.

Periodontal measurements:

Most of the patients undergoing orthodontic treatment develop moderate to generalized gingivitis. According to Zachrisson & Zachrisson et al.¹¹ the changes were observed within one or two months after the placement of the appliances. The similar findings were also suggested by Kobayashi et al. in 1964 & Rateitschak et al.³⁰ in 1968.

Our results were in accordance with Turkkhraman et al.³ study in which there was no significant difference between GI, PI and GBI at any point of time. But statistically significant increase was seen from T₀ to T₁. Even Pejda et al.¹⁴ and Pandis et al.¹⁰ study showed no significant difference between In ovation – R SLB and Microarch CB with elastomeric ligation.

The results of our study were in contrary to the study of Fatma et al.⁶ Our results were contrary to the study conducted by Pellegrini et al.¹⁸ showed that conventional brackets with elastomeric ligation had more plaque accumulation compared to SLB's. The difference was statistically significant between SLB's and conventional brackets, due to variation in bracket design and method of ligation affected the amount of plaque accumulation.

Contrary to our results, study done by Nalcaci et al.¹⁶ Damon Q SLB group showed better values for

periodontal parameters than mini- Taurus conventional brackets with elastomeric ligation. The variation in the results of this study from our study may be due to elastomeric modules used for ligation of mini Taurus brackets which are prone to more plaque accumulation and bleeding as reported in various studies in contrast to the stainless steel ligatures used in our study.

Further research should be performed to assess the effect of size on microbial colonization & periodontal status of esthetic orthodontic brackets during early phase of orthodontic treatment.

SUMMARY AND CONCLUSION

Following conclusions were made from the present study:

- There was a statistically significant increase in microbial and periodontal parameters from T₀ to T₁ ($p < 0.05$).
- There was no statistically significant difference among the standard and mini brackets groups received from three different manufacturers at any point of time ($p > 0.05$).
- Standard brackets showed high values for colony count of both *S.mutans* and *lactobacillus* than mini brackets from all the manufacturers.
- Standard brackets showed high values for periodontal parameters than mini brackets from all the manufacturers.

So it was clear that as the size of the bracket increases, the inter bracket distance decreased hindering with proper oral hygiene maintenance leading to increase in plaque accumulation and microbial colonization.

Apart from size of brackets, other factors like oral hygiene maintenance and eating habits also play a role in determining plaque accumulation. So either of the brackets can be used in our regular practice on day to day basis as the microbial colonization and plaque accumulation depends on oral hygiene maintenance.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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