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RESEARCH ARTICLE

EVALUATION OF SHORT TERM EFFECT OF FIXED ORTHODONTIC THERAPY ON PERIODONTAL HEALTH

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ABSTRACT

Background: To determine the short term effect of fixed orthodontic therapy on periodontal health and to find out which of the ligation techniques adhere more amount of micro organisms.
Methods: Total of 30 subjects were selected in the age range of 18 to 25 years in the study. on the first day (T0) Quigely Hein plaque index was performed using two tone dye and bonding was carried out half of the quadrant was ligated with elastic module and half of the quadrant with steel ligature, patients were recalled after 2nd day(T1) of bonding, bracket bond index was carried out. same patients were recalled after 30th day of bonding, Quigely Hein and bracket bond plaque index were performed. Elastic module and steel ligature from either quadrant were removed and placed in the vials containing Stuart transport media were sent for total bacterial count.
Results: results were subjected for statistical analysis and it was found that Quigely Hein and Bracket Bond plaque indices revealed higher plaque scores on the side where elastomeric modules were used when compared to ligature wire.
Conclusion: Within the limitations of the study, the microbial counts were increased in case of elastic module than the steel ligature. Furthermore, the findings of the present study demonstrated a link between accumulations of more amount of plaque on elastic module than the steel ligature.

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INTRODUCTION

Fixed orthodontic treatment is the preferred and most common method for treating malocclusion. Improper maintenance of oral hygiene results in decay teeth, gingivitis, and periodontitis compromising the success of the orthodontic treatment which can affect the esthetic appearance of an individual. (Wang *et al*., 2007) Orthodontic treatment comprises of active components such as arch wires, springs, elastics and passive components such as bands, brackets, buccal tubes and ligature wires. Orthodontic ligation techniques are used to secure the arch wires to the brackets. They comprise of stainless steel ligatures wires and elastic modules. Earlier stainless steel ligatures (0.009 to 0.011 inch) were used to secure the arch wires to the bracket slot. Patient compliance was poor with this type of ligation technique hence elastic modules were introduced to overcome initial discomfort but the disadvantage with this technique was complete engagement of wire into the bracket slot does not occur. Newer ligation techniques have been introduced to reduce the friction between arch wires and bracket slots. (Moradinejad *et al*., 2015) Orthodontic appliances tend to enhance bacterial growth by providing a conductive environment. The bracket design and ligation technique provide additional surfaces and undercut areas for the collection and retention of food debries, contributing to more area for bacterial growth. Orthodontic ligation is considered as an additional factor for biofilm accumulation. (Bloom and Brown, 1964) Various changes that take place in the oral cavity of the patients during the course of treatment are the increase in the number of sites available for food accumulation, thereby increasing the accumulation of microorganisms. (Schie *et al*., 1984) The insertion of orthodontic wires tends to create new surface available for plaque formation and therefore increase the level of microorganisms in the oral cavity. Adhesion of microorganisms to surfaces is a result of electrostatic interactions and Vander-Walls forces. Although it is clear that initial attachment is an important factor governing further

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colonization, the mechanism of attachment and those of subsequent adhesion may differ significantly. Once attachment is established, additional factors may dictate further colonization. Decreased wettability may inhibit direct adhesion and colonization of bacteria on to the appliances (Sunil *et al*., 2015). Microbiological studies have established that after the placement of fixed orthodontic appliance the number of bacteria raises significantly. (Saloom *et al*., 2013) Accordingly a study conducted by Forsberg has shown difference in adhesion of microorganisms to the teeth ligated with elastomeric rings and ligature wire.

MATERIALS AND METHODS

This was a prospective study conducted on 30 patients, who reported to Department of Orthodontics. All the selected patients were explained about the need, design of the study and its potential benefits and were made to sign an informed written consent prior to commencement of the study.

Sample selection

Sample selection was done based on the following inclusion and exclusion criteria Inclusion criteria were patients with good health, permanent dentition, no clinical signs of gingival inflammation, patient with mal aligned teeth and the exclusion criteria were history of previous orthodontic treatment, Patients with systemic disorders, tobacco chewers, pregnant patients and lactating women, users of systemic medication for chronic disease, patient who have undergone periodontal treatment. Based on the above mentioned inclusion and exclusion criteria, total of 30 subjects were selected and divided into 3 groups based on time intervals

- T0- 1st day when the Quigely Hein Plaque Index was performed.
- T1- 2nd day Bracket Bond Plaque Index was performed.
- T3-30th day Quigely Hein Plaque Index and Bracket Bond Plaque Index was performed.

Clinical Procedure

The appropriate patients were selected and educated about the study and informed consent was taken. The patients were called on the first day (T0) and a two-tone dye solution was applied to the buccal tooth surfaces and left for 20 seconds. It was then rinsed and the tooth surface was dried and isolation was maintained. The disclosing agent differentiated between mature and immature plaque. Quigely Hein Plaque Index (William Quigely, 1962) was recorded using WHO Probe. Disclosing agent was removed from the tooth surface. Bonding was done and initial arch wire was placed. Half of the quadrant was ligated using elastic modules (Wang *et al*., 2007) and the other half of the quadrant was ligated with steel ligature wire (Moradinejad *et al*., 2015) Patient was recalled on the 2nd day (T1) and plaque was measured around the brackets using Bracket bond index (Kiliglou *et al*., 2007) with the help of WHO Periodontal probe. On 30th day (T2) Quigely hein plaque index and Bracket bond index were performed. The elastomeric ring and steel Ligature wire were removed and placed in sterile container containing transport media (Stuart media) (Bloom and Brown, 1964) and sent for colonization for total bacterial count within 6 hours. Samples were incubated under blood agar (Schie *et al*., 1984) at 37°C for 48 hours.

Indices performed

1. Plaque indices (William Quigely 1962).
2. Bracket bond plaque indices (Kiliglou et al., 1997).

Lab procedures

Stuart Media (Bloom and Brown, 1964)

Stuart media was originally described by Stuart in 1946. non-nutritive media was used as transport media which maintains the viability of micro organisms without significant multiplication. (Kyle *et al*., 2011)

Media Preparation

Luria Bertini Agar (LB Agar) (Schie *et al*., 1984)

Luria Bertani Agar was used for the cultivation and maintenance of recombinant strains Elastic module-3M UNITEK, Ligature wire-Rabbit force, Stuart media-Hi media, L B agar –Hi media, 3M UNITEK

Statistical analysis

The following methods of statistical analysis were used in the study.

1) Mean

Mean is the measure of middle of the distribution of a numerical variable. The mean is commonly used to describe numerical data that is normally distributed. The mean is the summing up of all observations and dividing the total by the number of observations.

Mean

The mean (denoted by x-bar) is calculated dividing the sum of the individual data (x) by the number of observations (n)

2) The Standard Deviation (SD)

It is defined as square root of the mean of the squares of all the deviations being measured from the mean of the observations and it is usually denoted by SD. It is calculated by the following formula:

$$SD = \frac{(x-\bar{x}^2)}{n}$$

3) Confidence interval

Confidence interval (CI) is an interval estimate of a population parameter. Confidence interval can be computed for any population parameter being represented by: mean, proportion, relative risk, odds ratio, and correlation, as well as for difference between two means, two proportions, etc. The ends

of the confidence interval are called confidence limits. Confidence intervals (CI) are defined as the values interval determined by sample mean and standard error where it is expected to find population mean.

According to the rules of normal distribution, the probability to find the population mean in that interval is:

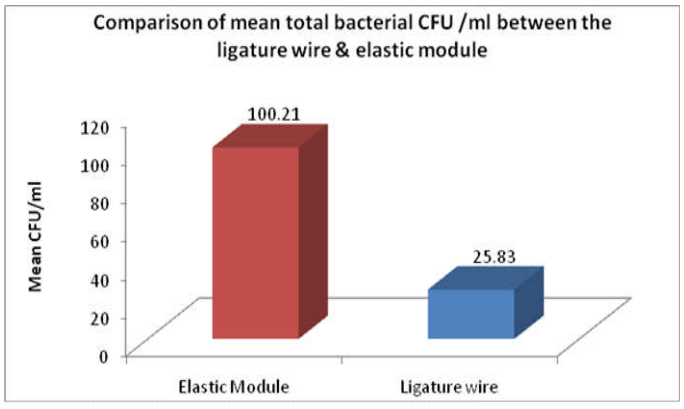
68.26% - SE) > CI < (+ SE)
94.95% - 2SE) > CI < (+ 2SE)
99.73% - 3SE) > CI < (+ 3SE)

Wilcoxon Signed-Rank Test

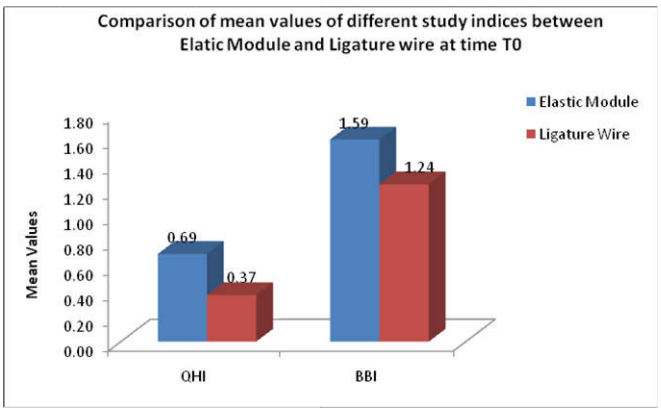
It's a non parametric statistical hypothesis test used when comparing two related samples, matched samples, or repeated measurements on a single sample to assess whether their population mean ranks differ (i.e. it is a paired difference test). It can be used as an alternative to the paired students t-test, t-test for matched pairs, or the t-test for dependent samples when the population cannot be assumed to be normally distributed. The test is named frank wilcoxon. The study data was analyzed using Statistical Package for Social Sciences (SPSS) Version 22 (IBM. Corp) for Windows. The CFU and the relevant indices were expressed in terms of mean ±SD. Since the study data did not follow normal distribution, non-parametric tests were used to compare the study parameters. The difference in the mean CFUs / ml, gender based comparison & including the indices values at different time intervals were compared between the ligature wire and elastic module using Wilcoxon Signed Rank test $P<0.05$ was considered as statistically significant.

RESULTS

A Wilcoxon signed rank test was conducted to compare the mean difference in the total bacterial CFUs / ml with respect to the ligature wire and elastic module. The test results revealed that the elastic module presented with a mean CFUs of 100.21 ± 25.98 as compared to the ligature wire with mean CFU of 25.83 ± 4.03, with a difference of 74.37 (95% CI (5.64 – 143.10)). Therefore, this comparison infers that the elastic module presents with a statistically significant increased bacterial colonization as compared to the ligature wire. (Graph no. 1) A Wilcoxon signed rank test was conducted to compare the mean difference in the scores of Quigley Hein Plaque index & Bracket bond index with respect to the ligature wire and elastic module at time T0 level. The test results revealed that the ligature wire presented with a mean Quigley Hein Plaque score of 0.37 ± 0.21 as compared to the elastic module with mean index score of 0.69 ±0.29, with a difference of 0.32(95% CI (0.27 – 0.38)).. (Graph no. 2)



Graph 1. Comparison of mean total bacterial CFU /ml between the ligature wire & elastic module using Wilcoxon Signed Rank test



Graph 2. Comparison of mean values of different study indices between Elastic Module and Ligature wire at time T0 using Wilcoxon Signed Rank test

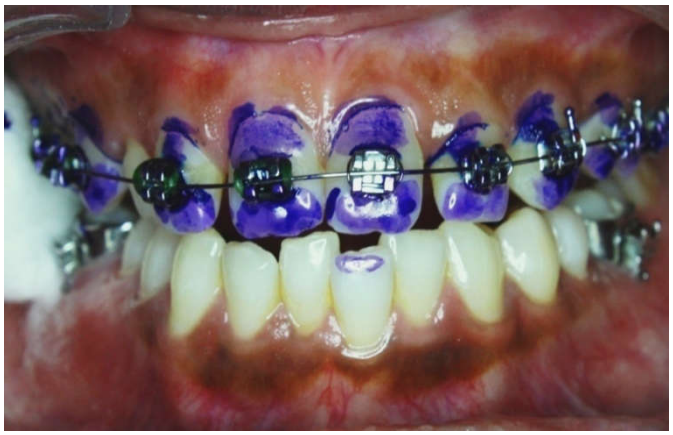


Fig. 1. Disclosing agent applied

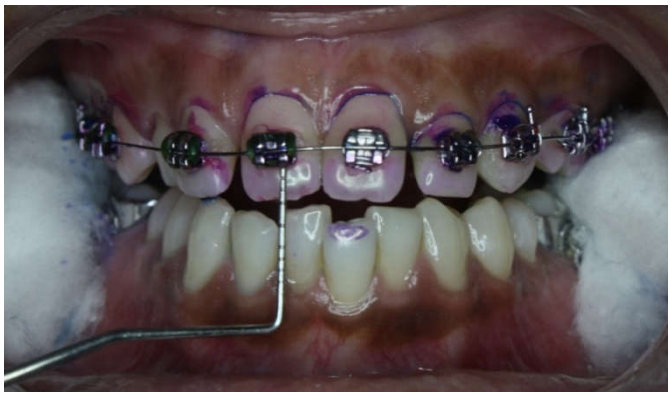


Fig. 2. Bracket bond index performed

Fig. 3. Elastic module removed for sample collection

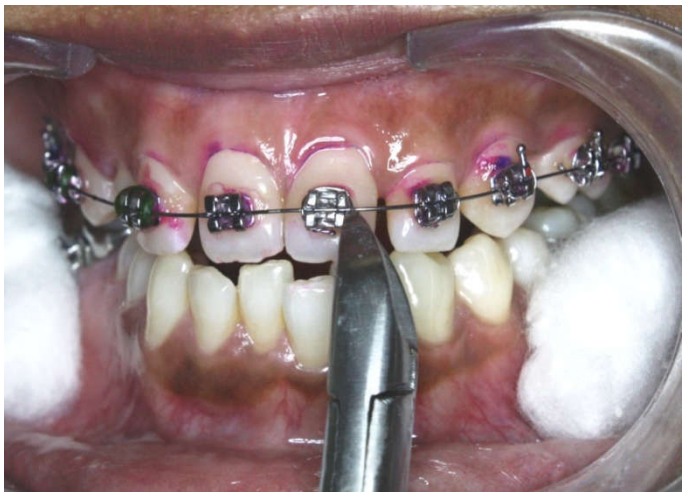


Fig. 4. Steel ligature removed for sample collection

Fig. 5. Vials containing modules and steel ligature sent for microbial culture

A Wilcoxon signed rank test was conducted to compare the mean difference in the scores of Quigley Hein Plaque index & Bracket bond index with respect to the ligature wire and elastic module at time T1 level. The test results revealed that the ligature wire presented with a mean Quigley Hein Plaque score of 1.92 ± 0.43 as compared to the elastic module with mean index score of 2.35 ± 0.43, with a difference of 0.43 (95% CI (0.35 – 0.51)). Ligature wire presents with relatively lesser indices mean as compared to elastic module.

Fig. 6. Sample of elastomeric module-colonies on culture plate

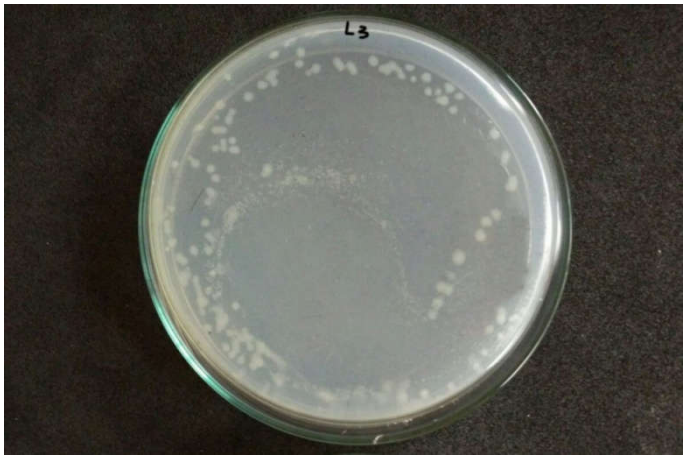


Fig. 7. Sample of ligature-colonies on culture plate

DISCUSSION

The use of various active and passive components of fixed orthodontic appliances has been the breeding grounds for bacterial colonization, thereby challenging proper oral hygiene maintenance. (Christersson *et al*., 1989) Patients who undergo orthodontic therapy have oral ecologic changes such as a low pH environment and an increased retention of food particles, which may lead to increased total bacterial count. (Ahn *et al*., 2002) This was an in-vivo study done on thirty orthodontic patients between the ages 14-25 years who presented with no signs of periodontal deterioration at the beginning of orthodontic treatment. The purpose of this study was to determine the short term effect of fixed orthodontic treatment on the periodontal health. The study also aimed at determining the differences in bacterial colonization around the two different archwire ligation techniques i.e. elastomeric modules and ligature wires. Change in periodontal health status was determined by comparing the Quigley Hein Index (Quigely and Hein, 1962) and the Bonded Bracket Plaque Index (Kilicogulu *et al*., 1997) values of the subjects taken one month apart. Quigley Hein Index is used to measure the progressive coronal extension of plaque covering the tooth surface and is scored

from 0 to 5. Bonded Bracket Plaque Index (BBPI) takes into account the effect of an orthodontic bracket on plaque distribution which is appropriate to compare the periodontal condition using two ligation methods though it is less suited to study the relationship between plaque and decalcification. This index also score from 0-5. Many studies have evaluated the effects of fixed orthodontic appliances in microbial flora and periodontal status, but only a few have evaluated the method of ligation as an additional factor. (Sunil *et al*., 2015) This study revealed that the teeth ligated with elastomeric rings exhibited greater number of microorganism as compared to the ones with ligature wire, the findings are statistically significant. This is in accordance with the study done by Hakkan *et al*. (1991) based on these findings they recommended that the use of elastomeric ligation rings should be avoided in patients with inadequate oral hygiene because elastomeric ligation, ligation rings will significantly increase microbial accumulation on tooth surfaces adjacent to the brackets, leading to predisposition for the development of gingivitis. Forsberg *et al*. (1991) reported statistically significant difference for adhesion of microorganism between the teeth ligated with elastomeric rings and ligature wire, this could be attributed to the differences in the sample size, registration times, statistical methods, or study design. In the present study Quigley Hein Plaque index & Bracket bond index with respect to the ligature wire and elastic module at time T_0 and T_1 level were carried out. The data found was statistically significant for elastic module for both the indices.

This could be due to the presence of brackets and wires which decreases the efficiency of tooth brushing in the interproximal areas. This causes high plaque index measurements. Inter dental toothbrushes or flossing may be of help to patients. Patients must be constantly informed about the merits of tooth brushing for better oral hygiene. In the present study plaque accumulation was assessed from beginning at different intervals of time period before and after placing the brackets and the samples of steel ligature wire and elastic modules was collected to culture the microorganisms.

Conclusion

The findings in this study demonstrated a possible link between fixed orthodontic treatment and accumulation of plaque. Within the limitations of the study, the microbial counts were increased in case of elastic module than the steel ligature. Furthermore, the findings of the present study demonstrated a link between accumulations of more amount of plaque on elastic module than the steel ligature. This will in turn increase more amount of adherence of microorganism on elastic module.

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