

# Evaluation Of Oral Hygiene Status During Fixed Orthodontic Treatment And Its Effects On Bond Failure Rate – An In Vivo Clinical Study.

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## Abstract:

**Background:** Research pertaining to the relationship between oral hygiene status of patients undergoing fixed orthodontic treatment and bond failure rate of orthodontic brackets is relatively scarce. The study aimed to probe into this relationship during the initial six months of treatment.

**Materials and Methods:** 40 patients (20 males and 20 females) between the ages 12-30 years were evaluated for a period of 6 months from the date of bonding. A data collection sheet was maintained for each patient. The oral hygiene status was assessed by using the Orthodontic Plaque Index(OPI) and recorded at each visit. Any bond failure (excluding those caused by trauma) including tooth number, sextant, arch and side of the mouth during the 6 months was also documented at each visit. The data was statistically analyzed and the effect of OPI scores on the bond failure rate was then evaluated along with the necessary correlations.

**Results:** Greater incidences of bond failure were associated with OPI score 4 (71.4%). Bond failures were seen mostly in the 19-24 year age group and in male patients (62.8%). The right maxillary second premolar (15) was the most frequently debonded tooth (25.7%). Bond failures occurred more in the S1 sextant (45.7%) than others, more in the maxillary arch (71.4%) and on the right side (54.3%). The last 3 months had more occurrences of bond failure (68.5%) with the fourth visit (V4) recording the highest incidences (28.6%).

**Conclusion:** Oral hygiene has an effect on the rate of bond failure in the first 6 months of fixed orthodontic therapy. The rate varies according to age, gender, tooth number, sextant, arch and side. This information may help in the formulation of individualized oral hygiene regimens for patients to attain faster and better results.

**Key Word:** Oral Hygiene; Fixed Orthodontic Treatment; Bond Failure.

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## I. Introduction

Fixed appliance therapy in orthodontics is associated with increased retention of bacterial plaque due to the components used during the treatment such as brackets, bands, ligatures and orthodontic wires. These components obstruct the use of conventional oral hygiene procedures as well as physiological mechanisms of self-cleaning by the tongue and cheeks. This leads to further problems like white spot lesions, tooth decay and gingivitis. Maintenance of good oral hygiene is therefore essential to the success of fixed appliance therapy<sup>1</sup>.

Proper bonding is crucial to the success of fixed orthodontic treatment. Bond failure has been reported to occur mostly during the initial three to six months following bracket placement. The orthodontist loses control over the tooth movement and it also affects the motivation of the patient, treatment duration, costs and results<sup>2</sup>.

Factors causing bond failure have been widely studied. Contamination by saliva and blood, occlusal interference, high masticatory load and tooth brushing have been suggested as operator and patient factors that may cause bond failure<sup>3</sup>.

Further exploration of factors relating to bond failure will help the vigilant clinician to better understand and undertake appropriate measures in its prevention. One theme requiring consideration is the effect of oral hygiene status of the patient on the bond failure rate of orthodontic brackets. Research regarding the subject is limited and the association has not been adequately established<sup>4</sup>. The purpose of this study was to investigate the possibility of such a relationship in patients undergoing fixed orthodontic therapy during the

initial six months and also to probe into the effect of the patient’s age, gender, dental arch, region of the mouth and tooth type on the bond failure rate.

**II. Material And Methods**

The study was conducted in the Department of Orthodontics, Regional Dental College, Guwahati, Assam between the periods of September 2021 to August 2022. 40 patients (20 males and 20 females) who visited the department were included in the study after prior approval from the Institutional Ethics Committee.

The inclusion criteria for the study were:

1. Age range-12-30 years.
2. No prior orthodontic treatment experience.
3. Absence of any labial/buccal surface morphologic defects and/or restorations.
4. Not under any sort of medications.

Only those bond failures whose specific cause (e.g trauma) could not be attributed (recorded as spontaneous) were included.

Standard bonding procedure was followed for each patient by the same operator to maintain consistency and eliminate operator errors making sure no flash remained at the end of bonding. Thereafter an erythrosine dye-based plaque disclosing agent was applied liberally and the Orthodontic Plaque Index (OPI) score as given by Beberhold et. al.<sup>5</sup> was assessed to make sure that the score in the bonding appointment (Visit 0) was zero. Routine oral hygiene instructions were given to the patient and were they asked to report any incidences of bond failure to the operator. All such incidences were recorded in a bond failure chart maintained for each patient. The patient was then subsequently followed up for six months (V1-V6). Each time the patient reported for the scheduled appointment the OPI score for the patient was first recorded by the same operator using the same procedure described earlier in a separate chart. Any bond failure including tooth number, sextant, arch and side of the mouth was also documented at each visit. Thereafter the orthodontic appointment followed. The same procedure was carried out for a total of six visits for each patient.

The data collected was then statistically analyzed by using both descriptive and inferential statistical techniques with the help of the SPSS software (v20.0).

**III. Result**

The mean OPI Score was calculated for each month. The overall mean OPI score for the 6 months was 2.60 with the fourth month showing the highest mean of 2.75.

A total of 35 bond failures were noted. Maximum bond failures occurred during the fourth month of follow up (28.6%). The last three months of follow up were associated with more bond failures (68.6%) than the first three months (31.4%).

The OPI score of 4 was associated with maximum bond failures (71.4%). Statistically significant correlation ( $p < 0.001$ ) was also observed between OPI scores and bond failures from third month onwards.

The mean OPI score showed no statistically significant relationship between the different age groups in the study. A slightly higher mean OPI score was noted for the 19-24 years age group. No statistically significant relationship was observed between the different age groups and bond failures.

Males had a statistically significant higher mean OPI score than females. They also had more bond failures compared to the females during the six months which was statistically significant.

The maxillary arch had a higher mean OPI score ( $2.20 \pm 0.80$ ) than the mandible. The maxillary arch had significantly higher bond failures (71.4%) compared to the mandibular arch ( $p < 0.001$ ).

The right posterior region of the mouth had a higher mean OPI score ( $2.35 \pm 0.42$ ) compared to the other regions. It also had significantly higher bond failures (62.9%) compared to the other regions.

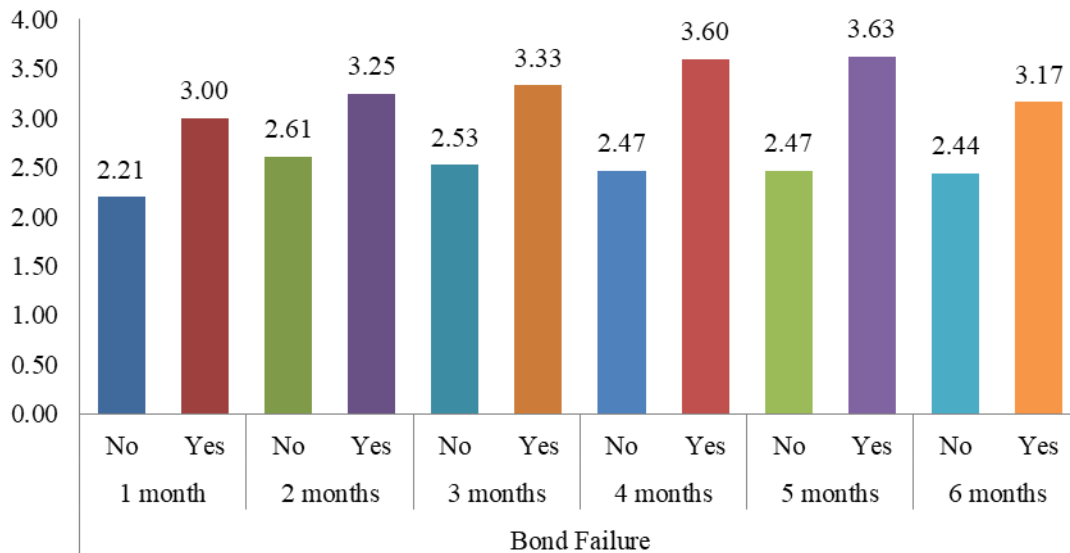
The mean OPI score of Sextant 1 was higher than the other sextants. The S1 Sextant also had statistically significant bond failures (45.7%) compared to the other sextants.

The right maxillary second premolar -15 was observed to be involved in maximum bond failures (25.7%) compared to all other teeth.

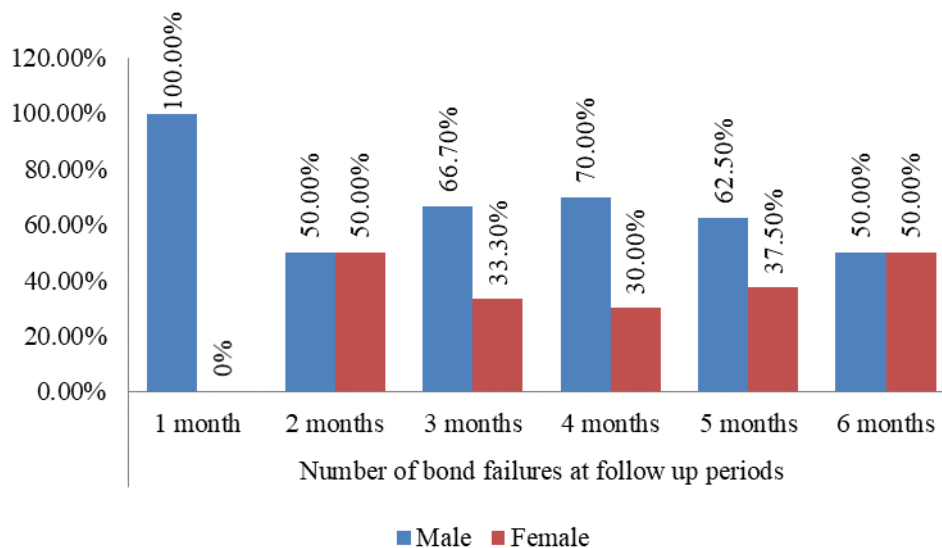
OPI Scores		Number of bond failures at follow up periods						Total bond failures
		1 month	2 months	3 months	4 months	5 months	6 months	
0	Count (%)							0 (0%)
1	Count (%)							0 (0%)
2	Count (%)			1 (16.7%)				1 (2.9%)
3	Count	1 (100%)	1		1	2 (25%)	4 (66.7%)	9

	(%)		(25%)		(10%)		(25.7%)
4	Count (%)		3 (75%)	5 (83.3%)	9 (90%)	6 (75%)	25 (71.4%)
Total	Count (%)	1 (100%)	4 (100%)	6 (100%)	10 (100%)	8 (100%)	35 (100%)
P value		NA	0.313	0.102	<b>0.011, S</b>	0.157	<b>p &lt; 0.001, S</b>

**Table 1:** Individual OPI scores related to bond failures at follow up periods.



**Figure 1:** Diagrammatic representation of the relationship between mean OPI scores and bond failures at follow up periods.



**Figure 2:** Diagrammatic representation of the bond failures in males and females.

#### IV. Discussion

Good oral hygiene maintenance is imperative to the duration and success of fixed orthodontic treatment. At the same time the success of bonding is an essential part of orthodontic therapy as bond failure during treatment adversely affects the length and outcome of the treatment<sup>6</sup>. The current research regarding the relationship being scarce, this study aimed to probe into the presence of an association between oral hygiene status of patients undergoing fixed orthodontic treatment and bond failure as well as to better understand the characteristics associated with it.

We noted a generally upward trend of mean OPI scores during the initial three months post the bonding procedure, peaking in the fourth month (mean OPI 2.75). This is in agreement with similar studies on the matter<sup>7,8</sup>. A likely explanation for this trend can be that the initial enthusiasm of the patients to maintain oral hygiene decreases with time. However, we also noted a downward trend during the fifth and sixth months in contrast to other studies.

Bond failure was reported for a total of 35 brackets during the 6 months with 31.4% occurring during the first three months 68.6% occurring during the last three months of treatment. This is contrast to the findings of Hegarty and Macfarlane<sup>2</sup> who reported that majority of the bond failures occurred within the first 3 months but is in line with the findings of O'Brien et al<sup>9</sup>.

It is interesting to note that bond failure rates were highest in the fourth month. This may have acted as a motivating factor for the patients to maintain better oral hygiene which would explain the downward trend in the mean OPI score noted in the fifth and sixth months.

On relating the individual OPI scores to the bond failures we found that 71.4% of all bond failures (71.4%) occurred when the OPI score was 4 (the highest score in the index). Similar findings were observed by Al Duliomy<sup>4</sup> who noted that 66.6% of the bond failures were related to the OPI score of 4. This shows that an increased OPI score, indicative of poor oral hygiene status, is associated with increased likelihood of bond failure. Increased OPI score implies higher accumulation of plaque around the brackets. Steffen<sup>10</sup> showed that the wash out of acids from the tooth surfaces was prevented by increased plaque accumulations which in turn increased the pH of the oral cavity. Acids around the brackets can lead to enamel erosion and Oncag et al.<sup>11</sup> noted attachment of brackets is negatively affected by enamel erosion.

No statistically significant correlation was observed between OPI scores, bond failures and different age groups. A recent study by Roelofs et al.<sup>12</sup> confirms this finding. However, the studies by Al Duliomy<sup>4</sup> and Mei and Chieng<sup>13</sup> found more bond failures in the younger age groups. However, attention must be paid to the age range included in the different groups in these studies. The probability of comprehensive fixed orthodontic treatment is less likely to in patients as young as 7 years in their mixed dentition who were also included in these studies.

Males had a consistently higher mean OPI as well as a higher number of bond failures during the six months of study. This finding is well established in similar studies on the subject by Al Duliomy<sup>4</sup> and Aikins and Ututu<sup>14</sup> who found comparable results. Azodo and Unamatokpa<sup>15</sup> found that gender differences played an important role in the perception of oral health and that females paid significantly more attention to their oral hygiene. Adofsson et al.<sup>16</sup> noted that greater bond failures could be due to the reason that females are generally more careful than males in the maintenance of their fixed orthodontic appliances. In contrast Roelofs et al.<sup>12</sup> found no such gender predilection.

The mean OPI score and bond failure rates were higher in the maxilla compared to the mandible. Furuichi et al.<sup>17</sup> studied the distribution of dental biofilm in non-orthodontic samples and noted more biofilm associated with the mandible compared to the maxilla. However, it must be kept in mind that patients undergoing fixed orthodontic treatment present a different oral environment and may differ in the pattern of biofilm formation. The work of Al Duliomy<sup>4</sup> and Mei and Chieng<sup>13</sup> who studied orthodontic patients undergoing fixed appliance treatment, report findings consistent with the present study.

The right posterior region of the mouth showed a higher mean OPI score and statistically significant bond failures associated with it. This is in contrast to the reports by Aikins and Ututu<sup>14</sup> who found more bond failures on the left side and Al Duliomy<sup>4</sup> who found a higher incidence of bond failures in the anterior regions. The studies of Pandis et al.<sup>18</sup> and Murfitt et al.<sup>19</sup> however report that the right side and the posterior regions of the mouth are more likely to experience higher bond failure. This can be explained by the findings of Inada et al.<sup>20</sup> who noted that the frequency of motion of toothbrush was higher on the left side compared to the right which would account for more biofilm formation on the right side. In addition, as reported by Kloehn and Pfeifer<sup>7</sup> the posterior regions are less likely to be subjected to thorough brushing and are more prone to food impaction and higher biofilm formation.

The S1 sextant, corresponding to the right maxillary posterior region, had the highest mean OPI score and bond failures (45.7%) over the six months and also included the tooth type most frequently experiencing bond failure- the right maxillary second premolar 15. This is consistent with the study by Aikins and Ututu<sup>14</sup> but is in contrast to Al Duliomy's<sup>4</sup> finding of more bond failure related to the maxillary lateral incisors and canines. The findings of the present study can be explained by poor oral hygiene maintenance in the right upper maxillary region and enhanced biofilm accumulation as noted previously. Also Whittaker<sup>21</sup> reports the presence of greater aprismatic enamel in the posterior teeth. Hobson et al.<sup>22</sup> noted that this decreases effective acid etching of the enamel surface resulting in a weaker bond due to reduced resin penetration.

## V. Conclusion

There seems to be a definite relationship between the oral hygiene status of patients undergoing fixed orthodontic treatment and the bond failure rate of orthodontic brackets. The higher the OPI score of a patient, the higher is the probability of bond failure. The OPI scores show an upward trend, peak at the fourth month and then follow a downward trend. The peak of the fourth month is associated with maximum bond failures. There was no association between the OPI scores in different age groups and bond failures. Males had a higher OPI score and bond failures compared to females. The maxillary arch was associated with a higher OPI score and higher bond failures in contrast to the mandible. The right posterior region and the S1 sextant were also seen to have higher OPI scores and more bond failures. Lastly, the right maxillary second premolar was associated with the highest bond failures. Further studies are required on a larger scale to determine the related characteristics so as to better understand this relationship between oral hygiene status and bond failure rate.

## References

- [1]. Cerroni S, Pasquantonio G, Condò R, Cerroni L. Orthodontic Fixed Appliance And Periodontal Status: An Updated Systematic Review. *Open Dent J.* 2018; 12: 614-622.
- [2]. Hegarty Dj, Macfarlane Tv. In Vivo Bracket Retention Comparison Of A Resin-Modified Glass Ionomer Cement And A Resin-Based Bracket Adhesive System After A Year. *Am J Orthod Dentofacial Orthop.* 2002;121: 496 – 501.
- [3]. Vijayakumar Rk, Jagadeep R, Ahamed F, Kanna A, Suresh K (2014). How And Why Of Orthodontic Bond Failures: An In Vivo Study. *J Pharm Bioallied Sci.* 6: 85-9.
- [4]. Al-Duliamy Mja. The Effect Of Oral Hygiene Status On The Bond Failure Rate Of The Orthodontic Bracket: An In Vivo Clinical Study. *Journal Of Oral And Dental Research.* 2018; 5:2.
- [5]. Beberhold K, Sachse-Kulp A, Schweska-Poll R, Horneckerand E, Ziebolz D (2012). “The Orthodontic Plaque Index: An Oral Hygiene Index For Patients With Multibracket Appliances.” *Orthodontics.* 13(1): 94–99.
- [6]. Cozzani M, Ragazzini G, Delucchi A, Mutinelli S Barreca C, Rinchuse Dj, Servetto R, Piras V. Oral Hygiene Compliance In Orthodontic Patients: A Randomized Controlled Study On The Effects Of A Post-Treatment Communication. *Progress In Orthodontics.*2016; 17:41.
- [7]. John S. Kloehn, John S. Pfeifer. The Effect Of Orthodontic Treatment On The Periodontium. *Angle Orthod.* 1 April 1974; 44 (2): 127–134
- [8]. Lundström F, Hamp Se, Nyman S. Systematic Plaque Control In Children Undergoing Long-Term Orthodontic Treatment. *Eur J Orthod.* 1979; 2(1):27-39.
- [9]. O'brien Kd, Read Mj, Sandison Rj, Roberts Ct. A Visible Light Activated Direct-Bonding Material: An In Vivocomparative Study. *Am J Orthod Dentofacial Orthop.* 1989;95: 348 – 351.
- [10]. Steffen Mj. The Effects Of Soft Drinks On Etched And Sealed Enamel. *Angle Orthod.* 1996; 66:449–456.
- [11]. Oncag G, Tuncer Av, Tosun Ys. Acidic Soft Drinks Effects On The Shear Bond Strength Of Orthodontic Brackets And A Scanning Electron Microscopy Evaluation Of The Enamel. *Angle Orthod.*2005; 75:247–253.
- [12]. Roelofs T, Merkens N, Roelofs J, Bronkhorst E, Breuning H. A Retrospective Survey Of The Causes Of Bracket- And Tube-Bonding Failures. *Angle Orthod.*2017; 87:111-7
- [13]. Mei L, Chieng J. Factors Affecting Dental Biofilm In Patients Wearing Fixed Orthodontic Appliances. *Proqorthod.*2017;18 (1):8-11.
- [14]. Aikins Ea, Ututu C. An Audit Of Bonding Failure Among Orthodontic Patients In A Tertiary Hospital In South-South Nigeria. *Int J Orthodrehabil.*2017;8: 91-5.
- [15]. Azodo Cc, Unamatokpa B. Gender Difference In Oral Health Perception And Practices Among Medical House Officers. *Russian Open Medical Journal.*2012; 1: 0208.
- [16]. Adolfsson U, Larsson E, Ogaard B. Bond Failure Of A No-Mix Adhesive During Orthodontic Treatment. *Am J Orthod Dentofacial Orthop.*2002; 122:277-81.
- [17]. Furuichi Y, Lindhe J, Ramberg P, Volpe Ar. Patterns Of De Novo Plaque Formation In The Human Dentition. *J Clin Periodontol.* 1992; 19:423–33.
- [18]. Pandis N, Polychronopoulou A, Eliades T. Failure Rate Of Self-Ligating And Edgewise Brackets Bonded With Conventional Acid Etching And A Self-Etching Primer: A Prospective In Vivo Study. *Angle Orthod.*2006; 76:119-22.
- [19]. Murfitt Pg, Quick An, Swain Mv, Herbison Gp. A Randomized Clinical Trial To Investigate Bond Failure Rates Using A Self-Etching Primer. *Eur J Orthod.* 2006;28(5):444-9.
- [20]. Inada E., Saitoh, I., Yu, Y. Et Al. Quantitative Evaluation Of Toothbrush And Arm-Joint Motion During Tooth Brushing. *Clin Oral Invest.*2015;19, 1451–1462.
- [21]. Whittaker D. Structural Variations In The Surface Zone Of Human Tooth Enamel Observed By Scanning Electron Microscopy. *Archives Of Oral Biology.* 1982; 27:383–392.
- [22]. Hobson Rs, Mccabe Jf, Rugg-Gunn Aj. The Relationship Between Acid-Etch Patterns And Bond Survival In Vivo. *Am J Orthod Dentofacial Orthop.* 2002; 121:502–509.