**Manuscript**

**Introduction:**

Dental caries and periodontal diseases have historically been considered the most important global oral health burdens.1 Malocclusion has been graded as the third dental public health problem by World Health Organization.2 The prevalence of malocclusion varies between different populations, ethnicities and age groups. 3,4,5,6  There has been increase in number of patients undergoing orthodontic therapy mainly to improve their Dentofacial esthetics and also for medical and dental reasons.7 Usually orthodontic patients evaluate treatment outcomes in terms of their smiles and overall enhancement in their facial appearance neglecting the consequences of orthodontic treatment.8

Orthodontic treatment with fixed appliances based on brackets and archwires creates numerous plaque retention sites and thus increases a patient’s risk of developing caries and inflammatory reactions in gingival tissue. In addition, the majority of patients undergoing orthodontic treatment are teenagers. This may also enhance the risk of poor compliance regarding plaque control and prevention.9 Several reports have documented significant increases in oral bacteria during orthodontic treatment.10,11 Some researchers believe that orthodontic therapy makes good oral hygiene more difficult, modifying the oral environment. After removal of bands and brackets at the end of active orthodontic treatment, clinical examinations often identify the presence of carious lesions and gingival inflamation which may range in severity.

However, descriptions of changes in the oral health status of dental patients during orthodontic therapy are sparse in the literature. The available scientific literature has assessed oral health status before and after the orthodontic therapy. Hence, an attempt has been made to assess the oral health status in patients who are currently undergoing fixed orthodontic treatment.

**Material and Methods**

The present study is a cross- sectional descriptive study. Prior to the start of the study, a protocol of the intended study was presented to the Institutional Ethical Review Board and later ethical clearance for the present study was obtained. The study population consists of 253 patients (78 males & 175 females) aged between 15-24 years undergoing fixed orthodontic treatment and were randomly selected from the Department of Orthodontics and Dentofacial Orthopedics at Private Dental Institute (criteria based random sampling). An informed consent explaining the study design and purpose was also obtained from every patient prior to their participation in the study. The patients with any systemic disease, cleft lip and cleft palate, history of taking any antibiotics for last 3 months and those undergoing periodontal treatment were excluded from the study. The study was systematically scheduled for a period of 5 months from January 2014 to May 2014. Schedule for the examination was prepared well in advance. On an average, 4-6 patients were examined per day during the study period.The examination protocol included a clinical examination under direct illumination on a dental chair using a light reflector and a three way syringe.

The clinical examination of every patient was carried out by single investigator (KJ). Before the start of the survey, the examiner was trained and calibrated at the department of Public Health dentistry, Private Dental Institute, in order to limit the intra-examiner variability. The calibration was done on small group of subjects. To determine intra-examiner variability, the oral examination of 10 randomly selected subjects was repeated on different dates. The results so obtained were subjected to Kappa statistics.

**Clinical examination:**

Clinically oral health status was assessed with a mouth mirror and a periodontal probe under clinical lighting, prior to and after drying the tooth surface with compressed air according to the World Health Organization caries diagnostic criteria for epidemiological studies.12 A surface was marked as ‘decayed’ when any of the following was observed: unmistakable cavitation on the tooth surface; a detectable softened floor or wall, or remaining, carious roots; and a filled surface with signs of caries. Caries occurrence was expressed as the decayed, missing (due to caries), and filled permanent surfaces (DMFS).13

 The health status of the gingiva was determined using Gingival Index (GI) according to Loe and Silness.14 The tissue surrounding each tooth was divided into four gingival scoring units and were accordingly probed -distofacial papilla, facial margin, mesiofacial papilla and entire lingual gingival margin. Each of the four gingival areas is assessed according to the following criteria- 0- Normal gingiva, 1- Mild inflammation, slight change in colour, slight edema, no bleeding on probing, 2- Moderate inflammation, redness, edema, glazing, bleeding on probing, 3- Severe inflammation, marked redness and edema, ulcerations, tendency to spontaneous bleeding.

 Also, patient’s demographic details, treatment beginning date, treatment period, and type of malocclusion were determined and groups were separated by these determinations. Malocclusion was assessed according to Angle’s classification of malocclusion, based on the relation of lower first permanent molar to upper first permanent molar.15 The collected data was presented according to the type of malocclusion in to Angle Class I malocclusion, Angle Class II malocclusion and Angle Class III malocclusion. And according to the duration of treatment of the patients in to Group A: 0 - 90 days of treatment, Group B: 91-180 days of treatment, Group C: 181-270 days of treatment and Group D: more than 270 days of treatment. Statistical analysis was done using computer with aid of Statistical Package for Social Science 17.0 (SPSS Inc, Chicago, IL, USA). Data comparison was done by applying One Way ANOVA test. A *p* value < 0.05 was considered statistically significant.

**Results:**

 The kappa coefficient value for intra-examiner reliability was 0.86. This value reflected high degree of conformity in observations. Out of 253 subjects, 78 (30.83%) subjects were males and 175 (69.17%) subjects were females (Table 1). 125 (49.41%) subjects had Class I malocclusion; 97 (38.34%) subjects had Class II malocclusion and 31 (12.25%) subjects had Class III malocclusion (Table 2). 61 (24.11%) subjects were in group A (duration of treatment 0-90 days), 61 (24.11%) subjects in Group B (duration of treatment 91-180 days), 60 (23.72%) subjects in Group C (duration of treatment 181-270 days) and 71 (28.06%) subjects in Group D (duration of treatment > 270 days) (Table 3). The results of this study revealed that according to malocclusion DMFS score was highest in subjects with Class I (4.41 ± 2.25) malocclusion followed by subjects with Class III (3.24 ± 2.34) and Class II (3.71 ± 2.47) malocclusion. This was found to be statistically significant (p<0.05). GI score was highest in subjects with Class I (1.41 ± 0.37) malocclusion followed by subjects with Class II (1.25 ± 0.34) and Class III (1.15 ± 0.33) malocclusion. This was found to be statistically highly significant (p<0.001) (Table 4). According to duration of treatment DMFS score was highest in Group D subjects (4.94 ± 2.48) followed by Group C subjects (4.13 ± 2.32), Group B subjects (3.66 ± 2.45) and Group A subjects (2.59 ± 1.38). It was found to be increasing with increase in duration of treatment. This increase was found to be statistically highly significant (p<0.001). GI score was highest in Group D subjects (1.68 ± 0.34) followed by Group C subjects (1.38 ± 0.28), Group B subjects (1.14 ± 0.18) and Group A subjects (1.02 ± 0.19). It was also found to be increasing with increase in duration of treatment. This increase was found to be statistically highly significant (p<0.001) (Table 5).

**Discussion:**

In this study, the most important finding was a negative effect of orthodontic treatment on the oral health status of these patients. Descriptions of the effects of orthodontic treatment on the oral status in orthodontic patient populations during the treatment are limited in the literature. A few studies were carried out by clinical examinations with different methods such as fluorescence lights, scanning electron microscopy (SEM) and a cariogram study.16,17,18,19 Some authors suggested that orthodontic treatment with a fixed appliance may be compatible with an increased incidence of caries, and thus orthodontic treatment itself has always been criticized.16,20 However, some authors, found no relationship between fixed orthodontic treatment and caries experience.18,21,22 The outcome of the present study showed that orthodontic treatment with a fixed appliance increased the risk of oral hygiene status. This finding is in agreement with the results of several studies.11,16,23

In the present study, DMFS score and GI score was significantly highest in Class I malocclusion when compared to Class II and Class III malocclusion. These findings are consonant with study conducted by Shrestha S. et al and Alstad S et al respectively.24,25 Alstad S et al assessed the gingival status in subjects with Angle’s Class I and Class II malocclusion by means of bleeding point index (BPI).24 It was found to be increasing during the course of treatment. No comparison was done between the types of malocclusion. Reason for occurrence of high DMFS and GI score can be that, in Class I malocclusion, the occurrence of crowding is more prevalent than other types.26 Therefore, in Class I malocclusion, probably due to greater occurrence of crowding and other factors, dental caries gingival inflammation was more apparent than compared with other type of malocclusion. El- Mangoury NH. et al suggested that crowding is the predisposing factor for initiation and progression of gingival and periodontal pathosis resulting in difficulty in oral hygiene maintenance and creates improper proximal contacts.Difficulty in maintaining oral hygiene can result in a greater accumulation of the dental plaque which is considered a primary etiologic agent in dental caries and inflammatory gingival disease. Improper proximal contact leads to narrowing of embrasures and disruption of disease susceptible ‘Col’.27 Also, Horup N et al has shown significant relation between crowding and gingival inflammation.28

In the present study, it was found that, as the duration of treatment increases there is simultaneous increase in DMFS and GI score. These findings were in accordance with findings of Pejda S. et al, Shrestha S. et al, Zachrisson BU et al, Zachrisson S et al, Ristic M et al, Liu H et al and Karkhanechi M et al. 25,29-34 Pejda S. et al examined patients prior to fixed orthodontic appliance placement and twelve weeks after placement of fixed orthodontic appliance and found significant increase in DMFT index.29 Shrestha S. et al found subjects undergoing treatment for 6-12 months duration had 58.54%, 12-18 months had 64.86% and more than 18 months had 63.92% occurrence of dental caries.25 Zachrisson S reported greater increase in the gingival index scores one to two months after placement of orthodontic appliances. Thereafter, gingival index scores showed increase at subsequent appointments throughout the active treatment phase.31 Ristic M et al reported gingival inflammation after 3 months of fixed appliance placement.32 Liu H et al reported significant increase in GI during the first 3 months of appliance placement and significant decrease in GI during the first 6 months after appliance removal.33 Karkhanechi M et al reported greater mean GI scores after 6 weeks, 6 months and 12 months of fixed appliance placement.34

The probable reasons for such findings are; constant presence of fixed appliances and its attachment during the whole treatment creates new retentive places near gingival margins, accumulation of dental plaque and increase in growth of pathogenic bacteria. This results in changed host–microorganisms balance, leading to dental caries, gingival inflammation etc.32 Overhanging gingival margins of orthodontic bands causes prolonged irritation of gingiva and may leads to inflammation.35

Various studies have been conducted to assess oral health status before and after orthodontic treatment. The present study is the first of its kind in India, to assess the oral health status during orthodontic treatment based on different types of malocclusion and duration of treatment. It was found that the risk for dental caries and gingival health was high during the course of orthodontic treatment. It was observed that Class I malocclusion was prone for poor oral health. Moreover, it was observed that, outcome of orthodontic treatment as well as its consequences on oral health during the course of treatment should be kept in mind, both by clinician and patient to enjoy the quality of life.

**Conclusion:**

The findings of present study conclude that oral health status of patients during orthodontic treatment is poor and keeps on deteriorating as the duration of treatment progresses. These consequences of orthodontic treatment are inevitable but can be prevented or limited to a lesser extent. Therefore, constant motivation and repeated instructions regarding good oral health at regular intervals should be given great emphasis during the course of orthodontic treatment.

Moreover, from a public health perspective, problem of poor oral health during orthodontic treatment is an alarming challenge and warrants significant attention from both patient and clinician. Therefore, it is important for a clinician to examine the oral health status of patients before the start of orthodontic treatment and to decide whether the patient is eligible for the treatment or is at high risk for poor oral health and accordingly plan the treatment with proper oral hygiene instructions and motivation.

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**TABLES:**

**Table No. 1: Distribution of study subjects according to Gender**

|  |  |
| --- | --- |
| **Gender** | **N** |
| **Male** | 78 (30.83%) |
| **Female** | 175 (69.17%) |
| **Overall** | 253 (100%) |

**Table No. 2: Distribution of study subjects according to Malocclusion**

|  |  |
| --- | --- |
| **Type of Malocclusion** | **N** |
| **Class I** | 125 (49.41%) |
| **Class II** | 97 (38.34%) |
| **Class III** | 31 (12.25%) |
| **Overall** | 253 (100%) |

**Table No. 3: Distribution of study subjects according to Duration of Treatment**

|  |  |
| --- | --- |
| **Treatment****Duration Groups** | **N** |
| **Group A** | 61 (24.11%) |
| **Group B** | 61 (24.11%) |
| **Group C** | 60 (23.72%) |
| **Group D** | 71 (28.06%) |
| **Overall** | 253 (100%) |

**Table No. 4: Distribution of DMFS and GI score according to Malocclusion**

|  |  |  |  |
| --- | --- | --- | --- |
| **Type of Mal-occlusion** | **N** | **DMFS**(Mean ± SD) | **GI**(Mean ± SD) |
| **Class I** | 125 | 4.41 ± 2.25 | 1.41 ± 0.37 |
| **Class II** | 97 | 3.24 ± 2.34 | 1.25 ± 0.34 |
| **Class III** | 31 | 3.71 ± 2.47 | 1.15 ± 0.33 |
| **One Way ANOVA** | **F value =** 7.09**p value =** 0.001\* | **F value =** 9.09**p value =** 0.00\*\* |

\* p < 0.05, S \*\* p < 0.001, HS

**Table No. 5: Distribution of DMFS and GI score according to Duration of Treatment**

|  |  |  |  |
| --- | --- | --- | --- |
| **Treatment****Duration Groups** | **N** | **DMFS** (Mean ± SD) | **GI**(Mean ± SD) |
| **Group A** | 61 | 2.59 ± 1.38 | 1.02 ± 0.19 |
| **Group B** | 61 | 3.66 ± 2.45 | 1.14 ± 0.18 |
| **Group C** | 60 | 4.13 ± 2.32 | 1.38 ± 0.28 |
| **Group D** | 71 | 4.94 ± 2.48 | 1.68 ± 0.34 |
| **One Way ANOVA** | **F value =** 12.80**p value =** 0.00 \*\* | **F value =** 83.65**p value =** 0.00 \*\* |

\*\* p < 0.001, HS