LOWER ANTERIOR CROWDING AS A RISK FACTOR FOR PLAQUE ACCUMULATION IN PATIENTS BETWEEN 18 TO 25 YEARS OF AGE

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ABSTRACT

Plaque is a significant factor that leads to periodontal disease. One of the most common areas for plaque accumulation is the lower anterior region. Crowding acts as a predisposing factor for plaque accumulation and if not treated eventually will lead to periodontal disease. This retrospective study was conducted among patients who visited a private dental hospital in Chennai. The patients’ records were retrieved from the hospital's record management system. These patients had visited the hospital from June 2019 to March 2020. 833 patients with lower anterior crowding were included in the study. Retrospective analysis was done on the collected data and entered in an excel table. The same was transferred to SPSS software and descriptive and inferential statistics were done. From the total of 833 patients who had lower anterior crowding, 604 patients were found to have mild to severe plaque accumulation. The remaining 229 patients had no plaque as they maintained good oral hygiene in spite of lower anterior crowding. From this study we were able to correlate that the presence of lower anterior crowding strongly acts as a predisposing factor leading to plaque accumulation and eventually periodontitis. Male patients were found to have more plaque accumulation when compared to female patients, Pearson Chi Square value-1.231a, p value - 0.746 (not significant).

Keywords: Crowding, Lower anteriors, Periodontitis, Plaque accumulation, Predisposing factor
INTRODUCTION

Plaque is one of the most important predisposing factors leading to periodontal disease and dental caries. It mainly consists of complex microbial biofilm which is formed over the surface of the teeth [1]. The pellicle that is present comprises glycoproteins, phosphoproteins, lipids, albumins and lysozyme that lead to colonisation by pioneer species. This leads to the formation of a polysaccharide matrix which is formed by the bacteria. The bacteria adhere to this matrix and each other to produce unique properties within the biofilm [2]. The presence of the biofilm leads to an increase in the bacterial resistance to different antimicrobial agents which forms a strong ecosystem for the bacteria to thrive in [3,4]. Though the bacteria can adhere to most surfaces and sites in the oral cavity, certain sites have higher predilection for plaque formation such as the margin between tooth and gums, interproximal surfaces, occlusal pits and fissures [5]. The presence of orthodontic fixed appliances increases the possible build up of plaque due to poor oral hygiene or inability to reach all corners by the patient. The heterogeneity of dental plaque also means that bacteria may have indirect protection via adjacent microbes and their defences with gene transfer and mutations reducing susceptibility.

Plaque composition is greatly dependent on the indivisible host and response. Initial plaque formation is mainly due to the pioneer species which adhere to the salivary proteins and to the glycoproteins. These initial pioneer species grow and multiply leading to the secondary colonisation by Gram positive and negative species creating a more diverse bacterial colony until a ‘biofilm’ as described above is formed [5].

The role of bacteria in dental caries was proven through experimentation by Marsh and Martin in the year 1992 [5], leading to the formation of white spot lesions. In a study conducted by Gorelick et al, 1982[6] the authors suggested that up to 50% of the patients who underwent orthodontic treatment developed white spot lesions during the treatment. Epidemiological studies have helped to show a strong association between the presence of mutans streptococci and the initiation of smooth surface and fissure caries, whilst lactobacilli may contribute but not induce carious lesions [7].

Epidemiological and experimental studies have shown a strong association between the presence of dental plaque in the oral cavity leading to the development of periodontal diseases [8]. There are mainly two types of periodontal diseases namely gingivitis which is not associated with irreversible destruction of the periodontal tissues and periodontitis which is associated with periodontal attachment loss [9]. Many clinical studies show us that inflammation leads to increased flow of gingival crevicular fluid which leads to an increase in pH and temperature which helps in the growth of proteolytic obligate anaerobic species associated with periodontal diseases [5].
Various methods have been developed over the years to detect and measure plaque, they mainly include:

1. Visual detection
2. Disclosing tablets - e.g. plak lite [10]
3. Planimetric measurements – e.g. Quantitative Light-induced Fluorescence (QLf) [11,12]
4. Plaque indices

**Plaque indices** - index uses numerical values to describe the relative status of a feature on a scale with a defined upper and lower limit [13]. One of the most commonly used indice is the Plaque Index – Silness [14].

Proper tooth position is a very important factor in the overall preservation of the dental health and for proper function and the aesthetics. Deviations from the normal tooth morphology and position will lead to food accumulation and occlusal prematurities. Dental crowding is the most common cause of malocclusion and can be associated with any of the underlying skeletal jaw relationships. There may be many reasons why crowding arises such as a tooth size / jaw size discrepancy, mesial movement of posterior teeth resulting in a shorter arch length and retroclination of the lower incisors which also shortens the arch length [15].

It is of utmost importance to measure the degree of crowding in order to determine the need and pace of the required treatment. Various methods have been used to measure the same and the most commonly used measurement options are

1. Malocclusion index - [15]
2. Occlusion feature index – [16]
3. Little irregularity index - [17]

Periodontal disease is widely prevalent and leads to significant harm leading to premature tooth loss in severely affected individuals. Gingivitis is defined as inflammation of the marginal gingival tissues due to accumulation of dental plaque and is characterised by swelling and bleeding of the tissues. However, periodontitis is invariably associated with periodontal and gingival inflammation and gingivitis appears to be a prerequisite for the development of periodontitis [3].

Over the years based on the literature we were able to see that crowded teeth would impede oral hygiene and therefore predispose to periodontal/demineralisation problems and that treatment with orthodontic appliances should help reduce this susceptibility. In a research conducted by Van Gasetel et al [18], he was able to come up with a hypothesis that showed proper dental occlusion and alignment reduces plaque accumulation. A vast majority of the written literature depicts that plaque leads to periodontal disease. Malocclusion in the anterior teeth may be an aggravating factor for plaque accumulation as significant differences in plaque accumulation were seen as the degree
of incisor irregularity increased. This was not the case for posterior molars and premolars. The conclusion by the authors was that at the extremes of oral hygiene competency (i.e. excellent or very poor) the effect of crowding was masked [15].

Numerous researches have been conducted by our team previously in our university on various orthodontic bonding adhesives [19–21] mini-implants being used for anchorage in orthodontic treatment [22–26], the negative effect of obstructive sleep apnea on detention [27], analysis of recycled brackets [28], a newly developed apparatus for measuring orthodontic force [29], clinical reports [30–33], but there are not sufficient epidemiological studies with the data present. The idea of this study stemmed from the current interest in our community.

MATERIALS AND METHODS

Study Setting
The study was conducted with the approval of the Institutional Ethics Committee [SDC/SIHEC/2020/DIASDATA/0619-0320]. The study consisted of one reviewer, one assessor and one guide.

Study Design
The study was designed to include all dental patients in the age group 18-25 years with lower anterior crowding. The patients who did not fall into these inclusion criteria were excluded.

Sampling Technique
The study was based on a non probability consecutive sampling method. To minimise sampling bias, all case sheets of patients who had diabetes and hypertension were reviewed and included.

Data Collection and Tabulation
Data Collection was done using the patient database with the timeframe work 01 June 2019 and 31 march 2020. About 538 case sheets were reviewed and those fitting under the inclusion criteria were included. Cross verification was done with the help of Photographs. To minimise sampling bias all data were included. Data was downloaded from DIAS and imported to Excel, Tabulation was done. The values were tabulated and analysed.

Statistical Analysis
Descriptive statistics were performed using SPSS by IBM on the tabulated values. Chi-Square test was performed and the p value was determined to evaluate the significance of the variables it was used to evaluate the association between the age and gender with the prevalence of plaque accumulation in patients with lower anterior crowding. The results were obtained in the form of graphs and tables.

RESULTS AND DISCUSSION

It was observed in the study that a total of 833 patients had lower anterior crowding, of which 604 patients were found to have mild to severe plaque accumulation. The remaining 229 patients had no plaque as they maintained good oral hygiene in spite of lower anterior crowding. With respect to the plaque index, 37.5% of the patients had
mild plaque accumulation, 20.3% patients had moderate plaque accumulation, 14.8% of the patients had severe plaque accumulation and 27.5% had no plaque accumulation as they maintained good oral hygiene. From the results we were able to correlate that lower anterior anterior crowding was one of the most important factors leading to plaque accumulation.

Plaque distribution based on age showed that patients in the age group 18-21 years had comparatively lesser patients with all degrees of plaque accumulation while patients in the age group 22-25 years had a higher prevalence of plaque accumulation. This could be attributed to the lack of awareness in this group. Similarly based on gender the distribution pattern showed that male patients had more plaque accumulation compared to female patients.

In this study, the Plaque index given by Silness and Loe was used for assessment of patients' oral hygiene [14,34]. It was used to assess the correlation between the degree of lower anterior crowding and periodontal status, as done by Ainamo et al, Ingervall et al, Buckley et al [15,35,36]. In a study conducted by El-Mangoury et al,1987 [37], the study sample was divided into two groups: patient with and without crowding, they showed that the pretreatment plaque index of the crowded group was significantly greater than the non crowding group by a level of 0.01. They also showed from the study that the gingival index was also significantly greater than the normal group by a significant range of 0.05. This was also seen non agreeing with previously done studies on the same by Sandalli et al and Waerhaug et al [38,39].

In a research study done by Pretty et al and colleagues [11], the authors reported that malocclusion, improper tooth position and crowding leads to and increases the chances of developing periodontal disease. Another study by Poulton et al [16]reported that there was a significant correlation between crowding and plaque accumulation leading to periodontal pathosis. A study conducted by Buckley et al [36] concluded that there was a significant correlation between crowding, plaque and gingivitis. Waerhaug et al [39] concluded that the eruption of teeth into a crowded environment acts as a predisposing factor to premature loss of attachment in the adjacent teeth and downward progression of subgingival plaque and calculus formation eventually leading to periodontal at an earlier age.

Though a lot of supporting literature has been found on the same to establish a correlation based on statistical significance between crowding and plaque accumulation a few articles had disagreement with the current hypothesis. In various studies conducted [40–42] many authors concluded that there was no significant correlation between the two factors and plaque accumulation could be due to various other factors.

Many of the above mentioned studies concentrated on different aspects of irregularities of teeth in general while our study mainly concentrated on the crowding of the mandibular incisors. Thus future studies must be done to improve on a wider inclusion basis.
The study shows us that crowding in the anterior region of the mandibular arch acts as one of the most important predisposing factors for the initiation and progression of plaque accumulation and periodontitis. The difficulty in maintaining oral hygiene results in greater accumulation of dental plaque which is one of the primary etiologic agents in periodontal disease formation. The progressive nature of these conditions present a valid indication for orthodontic elimination of lower anterior crowding as an integral part of preventive periodontics. Orthodontically correcting lower anteriors crowding improves the periodontal status of the patient by reducing the plaque accumulation significantly.

Continuous motivation and instruction were necessary in patients with crowded teeth because the results of the research showed that lower anterior crowding is a risk factor leading to plaque accumulation. Oral hygiene can be maintained by tooth brushing, tissue stimulation, hydrotherapy and other procedures which helps to maintain oral health [43]. Besides maintaining oral hygiene with different methods, orthodontic treatment is the best way to overcome crowded teeth and helps in restoring crowded teeth into their normal arrangement [44]. Plaque control can be easily carried out when the teeth are in their normal position in the arch. Normal teeth arrangement permits the toothbrush to reach every surface of the tooth in order to eliminate all the plaque and calculus [45]. Regular maintenance of oral hygiene is very much needed by attending regular dental check up minimum once every six months.

CONCLUSION

Within the limits of our study we were able to conclude that lower anterior crowding was one of the most important predisposing factors leading to plaque accumulation and if not treated eventually will lead to periodontal disease. The study showed that male patients in the younger age group had higher prevalence of increased deposits, though it was not statistically significant. Nevertheless, fundamental and statistical interpretations of experimental studies never confirm or prove a hypothesis. Furthermore researches and clinical studies must be performed to establish and understand the correct cause of the plaque accumulation in crowding and elimination of the same as to how this will help us with current need to eliminate factors leading up to periodontitis.

AUTHOR CONTRIBUTION

All authors contributed equally to the work.

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REFERENCES


Figure 1: The graph represents the frequency of distribution of plaque accumulation in patients with lower anterior crowding. The X axis represents the severity of plaque accumulation and Y axis represents the total number of patients with lower anterior crowding. From this graph we see that most of the patients with lower anterior crowding had mild plaque accumulation (37.5%).
Figure 2: The graph represents the association between the age groups of the study samples and lower anterior plaque accumulation. X axis represents the age distribution. Y axis represents the total number of patients. The age group 21-25 years had more plaque accumulation when compared to the other age group. However there was no significant association between age and plaque accumulation. Pearson Chi Square test was done and p value was found to be 0.523, which is >0.05 hence statistically not significant.
Figure 3: The graph represents the association between the gender and the lower anterior crowding of the patient. X axis represents the gender distribution. Y axis represents the total number of patients. From this we were able to see that male patients had higher plaque deposition than female patients. However, there was no significant association between gender and plaque accumulation. Pearson Chi Square value was 1.231, p value = 0.746, p value >0.05 hence statistically not significant.