



Gingival health status in patients with and without anterior open bite: A case-control study

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ABSTRACT

Open bite is the absence of vertical overlap of lower incisors by upper incisors when posterior teeth are in occlusion. An anterior open bite can cause periodontal damage which leads to gingivitis and periodontitis. To assess the gingival health status in patients with anterior open bite and also compares with patients without an anterior open bite. Retrospective data collected from 89,000 case records from June 2019 to March 2020. The present study consisted of 76 patients divided into two groups: patients with anterior open bite and patients without an anterior open bite. In both groups, the following parameters were recorded - Oral Hygiene Index - Simplified (OHI-S) and Plaque Index (Silness and Loe). OHI-S index and plaque index was similar in patients with and without an anterior open bite. Mean Plaque Index for case group (patients with anterior open bite) is 0.76, and Mean Plaque Index for control group (patients without the anterior open bite) is 0.78. Mean OHI-S Index for case group (patients with anterior open bite) is 0.51, and Mean OHI-S Index for the control group (patients without the anterior open bite) is 0.53. The difference was not statistically significant (P-value > 0.05). In this study, gingival health status in patients with and without an anterior open bite is low.



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INTRODUCTION

(Subtelny and Sakuda, 1964) defined open bite as open vertical dimensions between the incisal edges of maxillary and mandibular teeth. However, loss of contact can occur between the anterior or buc-

cal segments. (Sassouni, 1969) classified open bite into dental and skeletal. (Proffit *et al.*, 1990) characterised patients with a skeletal open bite as a large total face like Long face syndrome. These patients have a disproportionately long lower facial third.

According to (Dawson, 1989), the major causes for the anterior open bite are the forces which result from thumb or finger sucking habits, pacifier use, lip and tongue habits, airway obstruction which leads to mouth breathing habits, enlarged tonsils and adenoids, skeletal growth abnormalities, occlusal and eruptive forces, dental ankylosis, postural mandibular imbalance. In younger children, major causes of the anterior open bite were non-nutritive sucking habits, and in adults, environmental causes are less important than skeletal factors (Ngan and Fields, 1997). Prolonged thumb sucking causes anterior open bite (Kelly *et al.*, 1973).

(Johnson and Larson, 1993) used the term non-nutritive sucking (NNS), which involves digits, pacifier sucking habits. There are two theories for the cause of non-nutritive sucking. Freud's psychoanalytic and learning theory (Ngan and Fields, 1997). (Adair, 1995) and (Adair *et al.*, 1992) conducted a study in 1995. They found the effects of orthodontic and conventional pacifiers on primary dentition and the results showed a statistical increase in overjet in the orthodontic pacifier group and significantly greater incidence of open bites in the conventional pacifier group when these groups were compared. (Straub, 1961) suggested that tongue thrusting habits can cause open bite, but there is no data to substantiate the claim.

(Tulley, 1969) classified tongue thrusting as an endogenous habit or an adaptive behavior based on facial morphology and swallowing pattern. Patients with skeletally disproportionately long faces are suspected of having airway obstruction. These patient facial appearances were characterised as Adenoid facies - cheeks are narrow, nostrils were narrow, and pinches, lips are separated, there are ex aggregated shadows beneath the eyes (Schendel *et al.*, 1976; Tourne, 1990). Harvold *et al.* (1981) reported that total nasal airway obstruction caused various developmental problems, but only a few developed Anterior open bite. Periodontal disease is mostly multifactorial with the common reason being the bacterial plaque (Löe *et al.*, 1965; Gibbons and Van Houte, 1973).

There are many treatment options available for correcting the anterior open bite. It includes fixed appliances with and without extraction of teeth, multi-loop edgewise appliance archwires, functional appliances, high pull headgear and or bite blocks. Severe open bite requires a combination of both orthodontic treatment and orthognathic surgery. Orthognathic surgery for open bite correction may be unstable (Reichert *et al.*, 2014; Burford and Noar, 2003).

The anterior open bite has its effect on lip incompetence, hyperplastic gingivitis, drying of the oral mucosa and loss of cleansing effect of saliva. Malocclusion can hinder the proper function of oral hygiene measures resulting in plaque and calculus formations, thereby disrupting the healthy state of the periodontium. Assessing the gingival health would provide an idea on the difference in the status of the accumulation of plaque and calculus, which would help in providing proper oral hygiene measures. Aim of the study was to assess the gingival health status in patients with anterior open bite and to compare with patients without an anterior open

bite and to create awareness about oral hygiene instructions among the patients.

MATERIALS AND METHODS

This is a retrospective study. This study was carried out in a hospital-based university setting. This study was evaluated and ethically approved by an institutional ethical review committee (Ethical approval number: SDC/SIHEC/2020/DIASDATA/0619-0320). Retrospective data collected from 89,000 case records from June 2019 to March 2020. Informed consent was obtained from the parents or guardian before starting the treatment. Inclusion criteria were patients with anterior open bite, patients aged from 10 to 35 years and patients without an anterior open bite (age, gender-matched control). Exclusion criteria were patients below 10 years of age and above 40 years of age, incomplete available data and improper photographs.

Total cases acquired for this study was 76 patients which include 38 anterior open bite patients and 38 age, gender-matched controls. OHI-S score was collected for patients with and without the anterior open bite. OHI-S index is the total of Debris Index and Calculus Index. To measure the OHI-S index, we divided each arch into three segments and measured the calculus and plaque on the buccal and lingual surfaces of each segment of both arches. After collecting all the required data, we calculated the values. The debris index was the total of all values obtained and divided by the total number of tooth surfaces in each segment. Calculus index was measured in the same way. The total of both was obtained. There are one reviewer and one investigator. One reviewer was to verify data with photographs in case records. OHI-S scores were collected for patients with and without an anterior open bite. If the OHI-S score is 0.1-1.2, oral hygiene is good, if the OHI-S score is 1.3-3.0, oral hygiene is fair, and if the OHI-S score is 3.1-6.0, oral hygiene is poor.

The Plaque Index was given by Silness and Loe in 1964. Plaque Index was also collected for the patients with and without an anterior open bite. Scoring criteria for Plaque index as follows. Score 0 represents no plaque. Score 1 represents a film of plaque adhering to the free gingival margins and adjacent area of the tooth. Score 2 represents the moderate accumulation of soft deposits within the gingival pocket or tooth and gingival margin, which can be seen with the naked eye. Score 3 represents an abundance of soft matter within the gingival pocket and or the tooth and gingival margin. If the plaque index score is 0.1-0.9, oral hygiene is

excellent, if the plaque index score is 1.0-1.9, oral hygiene is fair, and if the plaque index score is 2.0-3.0, oral hygiene is poor.

Selected case and control group were examined by three people; one reviewer, one guide and one researcher. Patient's case sheets were reviewed thoroughly. Cross-checking of data, including digital entry and intraoral photographs, was done by an additional reviewer. As a measure to minimise sampling bias, samples for the group were picked by the simple random sampling method. A digital entry of clinical examination and intraoral photographs were assessed. Then OHI-S score and plaque score was entered into Microsoft Excel (MS Excel) and then transferred into Statistical Package for the Social Sciences (SPSS) software for statistical results. A correlation test (Mann - Whitney test) was done between the patients with anterior open bite (case group) and patients without an anterior open bite (control group). The difference was considered statistically significant when the p-value was less than 0.05.

RESULTS AND DISCUSSION

The final study sample size included a total of 76 patients with 38 patients with anterior open bite (case group) and 38 patients without an anterior open bite (control group). (Figure 1) In this study, the control group was matched based on age and gender as similar to the case group. (Figure 2) The mean Plaque index score for patients with anterior open bite was 0.76, and the mean Plaque index score for patients without anterior open bite was 0.79. (Figure 3) Out of 38 patients with anterior open bite, 24 patients had fair Plaque index scores. Out of 38 patients without an anterior open bite, 13 patients had excellent, and 5 patients had poor plaque index scores, respectively (Figure 4).

The gingival status of patients without an anterior open bite, based on plaque index scores, was similar to patients with anterior open bite, which was not statistically significant. ($p = 0.920$) Mean OHI-S index of patients with anterior open bite was 0.51, and the mean OHI-S index of patients without anterior open bite was 0.53. (Figure 5) An equal number of patients in both the case and control groups had good OHI-S index scores. (Figure 6) The gingival status of patients without an anterior open bite, based on OHI-S index scores, was similar to patients with anterior open bite, which was not statistically significant ($p = 0.817$).

In Figure 1, note the equal distribution of cases in both case (patients with anterior open bite) and control group (patients without the anterior open bite)

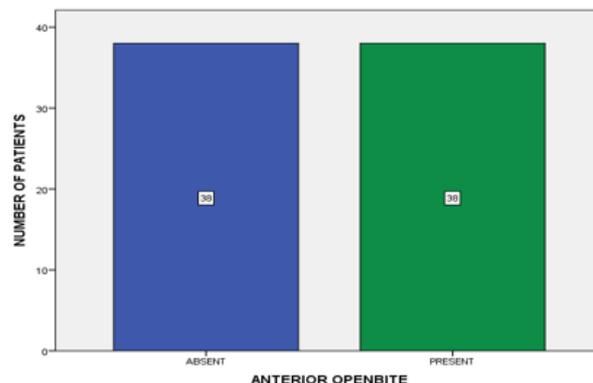


Figure 1: Bar graph represents the number of cases in case (patients with anterior open bite) and control group (patients without anterior open bite)

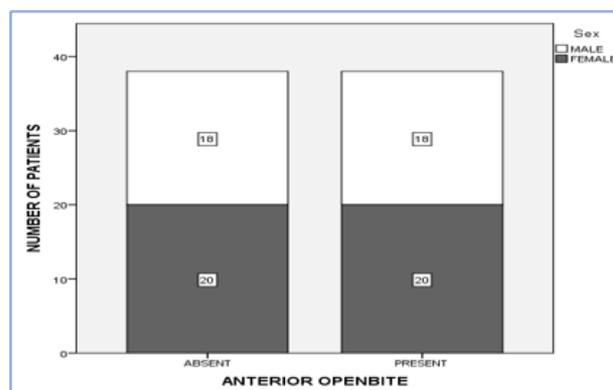


Figure 2: Bargraph represents the gender distribution of cases in case (patients with anterior open bite) and control group (patients without anterior open bite)

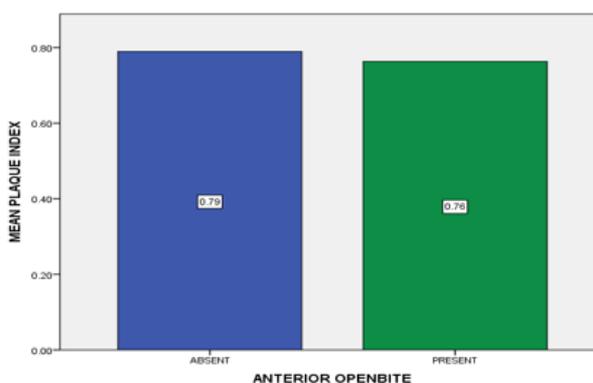


Figure 3: Bargraph represents the Mean Plaque Index in case (patients with anterior open bite) and control group (patients without anterior open bite)

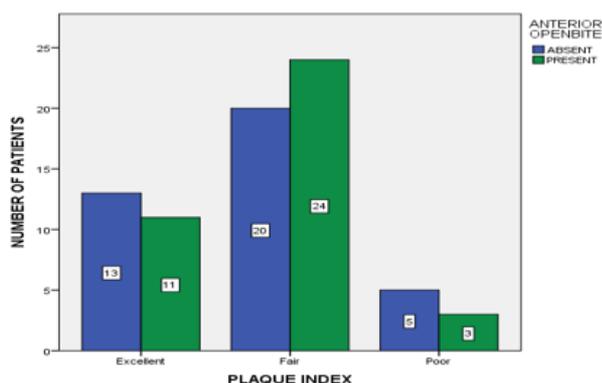


Figure 4: Bargraph represents the comparison of Plaque index scores among the patients with and without anterior open bite

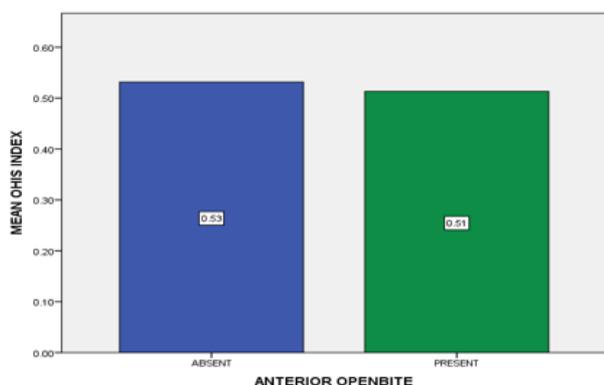


Figure 5: Bargraph represents the Mean OHI-S index scores in case (patients with anterior open bite) and control group (patients without anterior open bite)

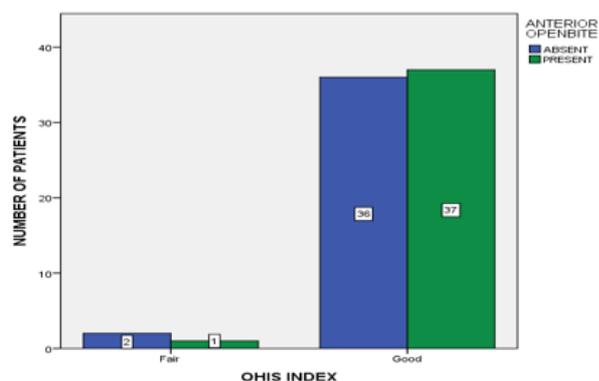


Figure 6: Bargraph represents the comparison of OHI-S index scores among the patients with and without anterior open bite

In Figure 2, note the equal distribution of cases in both cases (patients with anterior open bite) and control group (patients without the anterior open bite).

In Figure 3, Mean Plaque index score for patients with anterior open bite (0.76) was similar to the mean Plaque index score for patients without an anterior open bite (0.79).

In Figure 4, the majority of patients with anterior open bite had higher fair Plaque index scores when compared to patients without open bite who had higher-excellent and poor plaque index scores. However, this difference was not statistically significant. (Mann Whitney U test, p-value - 0.920 - not statistically significant)

In Figure 5, Mean OHI-S index of patients with anterior open bite (0.51) was similar to the mean OHI-S index of patients without an anterior open bite (0.53).

In Figure 6, there was no difference in OHI-S index scores in patients with and without an anterior open bite, which did not show any statistical significance (Mann - Whitney U test, p-value - 0.817 - not significant).

Anterior open bite is an increase in the vertical dimension between the maxillary and mandibular anterior teeth. There is usually a loss of incisal edge contact in opposing anterior teeth (Worms *et al.*, 1971). Etiology could be the posture of tongue in the interdental region compromising airway. (Profit and Fields, 1993) concluded that have shown that the constant force of soft tissue posture would lead to open bite. Periodontal diseases are multifactorial, and dental plaque plays an essential role in it. (Genco and Loe, 1993; Koral *et al.*, 1981) Host susceptibility like the local or general risk factors are predictors of periodontal status (Pennel and Keagle, 1977; Sheiham and Nicolau, 2000). They may be responsible for providing a suitable environment for bacterial colonization or interference in the inflammatory process (Ricardo *et al.*, 2016; Kina *et al.*, 2013).

The habit of mouth breathing would influence the inactive posture of the lips and tongue that would provoke an open vertical dimension between the incisal edges (Arat and Iseri, 1992; Arvystas, 1977). The constant pressure from buccinator muscle and the tongue creates neutrality which is the reason for the position of the tooth in the arch (Arvystas, 1977). The forward tongue placement due to a habit minimises the tongue pressure leading to a squeeze of the maxillary arch (Dawson, 1989). This leads to the high narrow vault, change in position of incisor teeth and anterior guidance (Dawson, 1989; Coa-

toam *et al.*, 1981; Boyd, 1978).

Anterior open bite leads to increase in FMA, increased lower facial height and incompetent lips which compromises esthetics. Repetitive tongue thrust could lead to periodontal compromise (Reichert *et al.*, 2014; Burford and Noar, 2003). Continuous tongue contact would induce bone loss, enhanced plaque accumulation leading to periodontal disease. The decrease in the salivary flow would reduce antibodies such as IgA, and leukocytes are thereby increasing the chances of periodontal destruction (Zubery and Machtei, 1991). Bechtold and Briegleb (2010) reported that higher plaque accumulation was noticed in the region of malocclusion. Kolawole and Folayan (2019) showed that moderate to severe gingivitis was present among patients with an anterior open bite.

Parents and children should work together to maintain good oral hygiene. Good attitude of parents reflects as good oral health in children and vice versa (Gurunathan and Shanmugaavel, 2016; Lakshmanan *et al.*, 2020). Preservation of primary teeth in the dental arch is important for optimal position of permanent teeth. Grossly decayed primary teeth which are extracted before exfoliation causes space in the dental arch which causes malocclusion if space maintainer was not given (Ravikumar *et al.*, 2017; Panchal *et al.*, 2019). Bacteria play a vital role in the initiation and progression of pulpal and periodontal disease (Jeevanandan, 2017). Untreated dental caries eventually leads to pulpitis and periapical periodontitis which is treated by means of root canal procedure (Govindaraju *et al.*, 2017b,c).

Fluoridated toothpaste should be used which removes dental plaque effectively thereby decreasing the incidence of oral disease (Ramakrishnan and Shukri, 2018; Somasundaram, 2015; Subramanyam *et al.*, 2018). A chewable toothbrush can be used instead of the manual toothbrush for effective removal of dental plaque (Packiri, 2017; Christabel, 2015; Govindaraju, 2017). Orthodontic corrections would improve periodontal health, thereby stabilizing the oral hygiene (Jeevanandan and Govindaraju, 2018; Govindaraju *et al.*, 2017a).

Advantages of this study were that this was a case-control study with age and gender-matched controls to provide best results with high internal validity, reasonable data, Disadvantage of the study was that this was a unicentric study with geographic limitations, limited sample size and had lower external validity. The dietary factors, feeding and oral hygiene factors were not taken into consideration while interpreting the results. Future scope for this study includes a larger sample size which is not con-

finied to a particular geographic area and to assess the plaque index and OHI-S index by clinically examining the anterior crossbite patients.

CONCLUSION

Within the limitations of the present study, the gingival status of patients without anterior crossbite based on OHI-S and Plaque index scores were similar to patients with an anterior crossbite. Despite the presence or absence of open bite, oral hygiene maintenance has to be emphasised in all the patients.

Author Contributions

1. Design - P.Kuzhalvaimozhi, Vignesh Ravindran
2. Intellectual content - Vignesh Ravindran
3. Data collection - P.Kuzhalvaimozhi
4. Data analysis - Vignesh Ravindran, Subhashini.V.C
5. Manuscript writing - P.Kuzhalvaimozhi.
6. Manuscript editing - Vignesh Ravindran, Subhashini.V.C

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Conflict of Interest

The authors declare that there are no conflicts of interest for this study.

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