Association of Celiac Disease with Dental Enamel Defects, Dental Caries, Oral Lichen Planus, and Aphthous Ulcers: A Prospective Cohort Study

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Abstract

Introduction Celiac disease (CD) may be linked to a range of oral symptoms, including dental enamel defects (DEDs). There is limited information on elucidating the precise connection and impact of a gluten-free diet (GFD) on these symptoms. We prospectively investigated the relationship between CD and DEDs in a large group of patients.

Material and Method A total of 264 biopsy-confirmed CD patients were recruited over a span of 3 years in a tertiary care referral facility. Matched controls ($n = 269$) were examined as well. A history of oral aphthous ulcers (OAUs) was recorded, and a single dentist conducted the dental examination. DEDs were categorized according to Aine's classification. Following the initiation of a GFD, patients were monitored for a minimum of 1 year. All dental findings were assessed by a senior second dentist.

Observations and Results DEDs were discovered to be more prevalent in patients with CD, and within this population, they were more frequent in participants with mixed dentition in contrast to subjects having permanent teeth. Additionally, oral lichen planus (OLP) and ulcers were more frequently observed in patients with CD. Nevertheless, there was no variation in the occurrence of dental caries between the two groups.

Conclusion This research demonstrates the link between CD and DEDs in children, with no such connection observed in adults. OAUs and OLP were found to be more prevalent in CD. Following 1 year on a GFD, there was an enhancement in both aphthous ulcers and OLP, but no improvement noted in enamel defects. CD should be included in the differential diagnosis for DEDs, OLP, and OAU. It is essential for all physicians and dentists to be informed of these associations to facilitate early diagnosis.

Keywords
- celiac disease
- enamel defects
- dental caries
- lichen planus
- aphthous ulcers

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Introduction

Celiac disease (CD) is a chronic autoimmune disorder characterized by an immune-mediated reaction to gluten, leading to inflammation and damage of the small intestine. This condition affects individuals with genetic predisposition and can present with a wide range of systemic and extraintestinal manifestations, including significant oral health complications.[1] Despite being primarily a gastrointestinal disorder, CD has been increasingly associated with various dental and oral conditions, which may serve as early indicators of undiagnosed cases.[2]

CD and its occurrence have notably risen over the last two decades. The occurrence in western nations is approximately 1% of the overall population. The female-to-male ratio has been inconsistently documented, with prospective population studies ranging from 1:3 to 1.5:1. More than 70% of the cases are diagnosed after 20 years of age.[3] The highest CD prevalence around the globe has been seen in Western Saharan population at 5.6%. In India, age-adjusted prevalence of celiac autoantibodies was 1.23% in northern India, 0.87% in northeastern India, and 0.10% in southern India. Prevalence of CD in North Indian community has been found to be 1:96. For each known case of CD, there are 53 undiagnosed individuals.[4] Although it can affect both genders at any age, female prevalence is more.[5]

The classical symptoms of CD are abdominal distention and pain, chronic diarrhea, anorexia, irritability, weight loss or failure to thrive in children, muscle wasting, and dermatitis herpetiformis. Nonclassical signs and symptoms are persistent vomiting, unexplained iron or folate deficiency, anemia, chronic constipation, delayed puberty, short stature, depression, and irritable bowel syndrome.[6]

One of the most common oral manifestations of CD is dental enamel defects (DEDs), affecting the integrity of the enamel. These defects are believed to result from malabsorption of essential nutrients, such as calcium and phosphorus, during tooth development. Additionally, individuals with CD often exhibit a higher prevalence of dental caries, potentially due to enamel defects, altered salivary composition, and a carbohydrate-rich gluten-free diet (GFD).[7]

Beyond enamel and caries-related complications, CD has also been linked to oral mucosal disorders, including oral lichen planus (OLP) and recurrent aphthous ulcer (RAU). OLP is a chronic inflammatory condition of the oral mucosa with autoimmune features, while RAUs are painful ulcers that frequently recur in individuals with nutritional deficiencies, a hallmark of CD due to impaired absorption of vitamins and minerals.[8]

Given the potential role of these oral manifestations in the early detection and diagnosis of CD, dental professionals play a crucial role in identifying at-risk individuals and facilitating timely medical intervention.[9] The purpose of this prospective cohort study was to evaluate the association of CD with DED, dental caries, OLP, and RAU, providing further evidence of the impact of CD on oral health and emphasizing the importance of interdisciplinary collaboration between dentists and gastroenterologists for comprehensive patient care.

Aims and Objectives

The aims and objectives of this study were:

- To correlate the association between CD and DEDs
- To correlate the association between CD and OLP and RAU
- To examine the considerable impact of CD on the occurrence of DEDs in both children and adults

Materials and Methodology

A total of 264 biopsy-proven CD patients were examined from clinics of Dayanand Medical College and Hospital, Ludhiana, Punjab, India, and Fortis Hospital, Ludhiana, Punjab, India. The following inclusion and exclusion criteria were taken into consideration in this study:

Inclusion criteria:
- The patients who consented to participate in the study.
- The patients with CD.
- Controls who consented for the study.

Exclusion criteria:
- The patients who did not consent for the study.
- Patients above the age of 50 years.
- Patients without CD.

A total of 269 controls were selected with the following criteria:
- Patients who did not have CD.
- Patients not related to CD patients.

Patients were subjected to routine systemic and oral examinations and findings were recorded on the prepared forms. Consent forms for participation were duly signed by the patients or guardians. A thorough oral examination was performed by a single dental professional.

Patients were examined by drying the teeth by wiping them with a 2×2 gauze and surfaces were examined. Changes in the oral mucosal epithelium were noted (presence of Wickham's striae, etc.). A single defect measuring < 1 mm in diameter was not recorded. The enamel defects affecting deciduous and permanent teeth were graded from 0 to IV according to Aine's classification.[10] Patients were questioned regarding the frequency and duration of RAU. Later, CD patients were put on a GFD and controls consumed a regular diet. The oral lesions were evaluated again with 1-year follow-up.

Observations and Results

Results were gathered, organized, and analyzed statistically using computer software; SPSS software for Windows. All qualitative variables were detailed in terms of frequency and percentage along with a comparison using the chi-square test. To evaluate the quantitative variables, Student's *t*-test was utilized.

Among CD patients ($n = 264$, mean age 38.2 ± 22.6 years) compared with controls ($n = 269$, mean age 34.8 ± 25.4

Table 1 Characteristics of the study sample

	Celiac disease *n* (%) *N* = 264	Controls *n* (%) *N* = 269	*p*-Value
Sex			
Male	160 (60.6)	171 (63.5)	0.90
Female	104 (39.4)	98 (36.5)	0.95
Age distribution			
Adult (≥ 18 y)	153 (58)	159 (59.1)	0.84
Children (< 18 y)	111 (42)	110 (40.9)	0.76
Dentition permanent	210 (79.5)	204 (75.8)	0.41
Dentition mixed	54 (20.5)	65 (24.2)	0.2
Age, mean ± SD (y)	32.2 ± 22.6	34.8 ± 25.4	0.08

Abbreviation: SD, standard deviation.

years), there were significantly more DEDs (64% vs. 27%, $p = 0.001$) (►**Table 1**).

DEDs were found to occur more frequently in individuals with mixed dentition than in those with permanent dentition (81% vs. 32.5%, $p = 0.001$). DEDs were more common in children (85% vs. 24%, $p < 0.05$) as compared with adults (29% vs. 22%, $p =$ not significant) (►**Table 2**).

The occurrence of dental caries was comparable between CD patients and the control group. However, OLP was more prevalent among celiac patients (16.4% vs. 7.6%, $p < 0.05$). Ulcers were much more frequent in coeliacs in children (24% vs. 13%, $p < 0.05$) as well as in adults (46.2% vs. 12%, $p < 0.05$).

Following the implementation of GFD at the 1-year mark, there was no notable enhancement in enamel defects. RAUs were frequently decreased in both children (24% before GFD vs. 10.8% after GFD, $p < 0.05$) and adults (46.2% before GFD vs. 14.4% after GFD, $p < 0.05$). Improvement in OLP was also observed.

Thirty-six patients (13.6%) presented first time at diagnosis with only enamel defects or aphthous ulcers, without any systemic manifestation.

Logistic regression models were applied, and three important predictors for DED were identified: age, CD, and mixed dentition (►**Table 3**).

Discussion

The findings of this study provide valuable insights into the relationship between CD and various oral health manifestations, including DEDs, dental caries, OLP, and RAU. The results reinforce the growing body of evidence linking systemic autoimmune disorders to oral health complications

Table 2 Occurrence rate of dental enamel defects

	Celiac disease *n* (%)	Controls *N* (%)	*p*-Value
Among all subjects	136 (51.5)	62 (23)	0.001
Among adults	44 (29)	35 (22)	ns
Among children	92 (83)	27 (24)	< 0.001
Among those with mixed dentition	43 (81)	21 (32.5)	0.0045
Among those with permanent dentition	72 (34)	51 (25)	0.5

Abbreviation: ns, not significant.

Table 3 Predictors for dental enamel defects

Predictors	Odds ratio (OR)	Confidence interval (95% CI)
Age (≥ 18 y versus < 18 y)	1.2	(1.1–1.3)
Celiac disease versus controls	2.4	(1.2–4.8)
Mixed dentition versus permanent dentition	5.2	(2.3–11.6)

and highlight the critical role of dental professionals in the early diagnosis and management of CD.

One of the most significant findings of this study is the high prevalence of DEDs among celiac patients, especially children. The DEDs were more noticeable in younger CD patients. Regression study revealed a substantial correlation between DEDs and children and people with mixed dentition.

Defects ranging from pitting and grossly to complete loss of enamel were seen. These defects are likely due to malabsorption of essential minerals like calcium and phosphorus during tooth development, particularly in childhood-onset CD. The correlation between the severity of CD and enamel defects suggests that undiagnosed or poorly managed CD may lead to more pronounced enamel anomalies. These findings emphasize the need for early screening in children presenting with idiopathic enamel defects, as it may serve as an oral marker for undiagnosed CD.[11]

The presence of DEDs in CD patients increases their susceptibility to dental caries.[12] Our study results have shown similar caries incidence in patients with CD and control.

This study also observed a significant association between CD and OLP. OLP is a chronic inflammatory condition with an autoimmune basis, and its increased prevalence in CD patients suggests a shared immunopathogenic mechanism. The presence of OLP in CD individuals may be due to chronic systemic inflammation, immune dysregulation, and cross-reactivity of autoantibodies. The association between these two conditions highlights the importance of regular oral mucosal examinations in celiac patients to detect early signs of OLP, which may otherwise remain asymptomatic until lesions become more pronounced.[13]

RAUs were found to be more prevalent in CD patients compared with the control group. These ulcers are often linked to nutritional deficiencies, particularly iron, folic acid, and vitamin B12 deficiencies, which are common in CD due to malabsorption in the small intestine. The findings support the hypothesis that persistent oral ulcers in otherwise healthy individuals should prompt screening for CD, particularly if accompanied by other systemic symptoms.[14] Effective GFD adherence has been shown to reduce the frequency and severity of RAUs, reinforcing the importance of dietary management in celiac patients with recurrent ulcerations.[15]

The findings of this study underscore the role of dentists and oral health care providers in the early identification of undiagnosed CD. Since oral manifestations often precede gastrointestinal symptoms, recognizing these signs can lead to earlier diagnosis and intervention, reducing long-term complications. The study further suggests that routine dental examinations should include screening for enamel defects, caries risk assessment, and mucosal lesions, particularly in individuals with a family history of CD or other autoimmune conditions.

Additionally, these results highlight the need for increased awareness among health care professionals regarding the oral implications of CD. Interdisciplinary collaboration between dentists, gastroenterologists, and nutritionists is crucial to ensure comprehensive patient care. Future studies should focus on longitudinal follow-ups to assess the impact of strict GFD on oral health outcomes, as well as investigating the potential role of probiotics and nutritional supplementation in mitigating these oral manifestations.

Limitations and Future Directions

Despite its strengths, this study has some limitations. The sample size, though adequate, may not fully represent the entire population affected by CD. Additionally, dietary habits, genetic predisposition, and environmental factors could contribute to variations in oral health outcomes and should be further explored. Future research should incorporate larger, multicenter studies with genetic and biochemical analyses to understand the precise mechanisms linking CD to oral pathologies.

Conclusion

This study proves the association of CD with dental defects in childhood but reveals no such association in adults. CD was found to be not associated with increased incidence of dental caries. OAU and RAU were common in patients with CD. After 1 year of GFD, improvement occurred in both, OAU and RAU, but no improvement was seen in DEDs. As the mouth is quite simple to inspect, oral lesions can offer significant clinical insight for the early identification of CD. Dentists need to recognize the connection between CD and oral health issues.

Conflict of Interest
None declared.

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