Mineralization Disturbances in Jordanian Children and Adolescents with Celiac Disease

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ABSTRACT

Objective: To investigate the presence and distribution of enamel defects and decayed-missed-filled teeth (DMF-T) in children and adolescents with mixed and permanent dentition who were diagnosed with celiac disease and to compare their oral findings with age and gender matched control group.

Methods: A prospective study was conducted at King Hussein Medical Center on a total of 86 patients. Forty-three patients with celiac disease who were regular attendants to the pediatric gastrointestinal clinic were compared to 43 healthy dental patients who attended the general dental practice outpatient clinic at the same hospital and were selected to match the study group by age and gender. Enamel surfaces were explored clinically for the presence and distribution of any symmetrical defects or hypo-plastic changes and scored according to the classification proposed by Aien which consists of four grades. Both study and control groups were examined for the number of decayed, missed and filled teeth (DMF-T) index.

Results: In both of the study and control groups, there were 26 females (60.5%) and 17 (39.5%) males. The mean age was 13.22±2.85 years for the study group and 13.35±2.59 years for the control group. Out of a total 86 patients, 37 (86.1%) of the celiac group was found to have enamel defects which was significantly higher than the control group (P value 0.007). The distribution of enamel defects was more in anterior than posterior teeth. The primary teeth in mixed dentition had shown zero enamel defects in both groups. The mean Decayed, Missed, Filled Teeth (DMF-T) was 7.15 for the study group while 6.78 for the control group with the P-value of 0.03 (decayed) 0.055 (missed) and 0.001 (filled). Caries free subjects comprise of 1 (2.32%) versus 11 (25.58%) in the study and control groups respectively.

Conclusion: The celiac group showed statistically significant more enamel defect and decayed and less filled teeth compared to the control group.

Key words: Celiac Disease, Enamel defects, Distribution, (DMF-T)

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Introduction

Celiac disease (CD) is a chronic enteropathy characterized by a permanent intolerance to dietary gluten and related proteins that result in immunological damage to the small intestine in genetically susceptible individuals.[1] The immune response to gluten provokes alterations in the small-bowel mucosa from the duodenum to ileum and characterized by lymphocyte infiltration, crypt hyperplasia, and atrophy of villi.[2] Identification of celiac disease is facilitated by widely available serologic tests, particularly serum anti-endomysial and anti-tissue transglutaminase antibodies, but definite diagnosis needs small bowel biopsies and the demonstration of villous atrophy with improvement or normalization on a gluten-free diet.[3] Celiac disease is a common disorder worldwide, its prevalence in United States was found to range from 1:22 in high risk individuals (first degree relatives) to 1:133 in healthy individuals.[4] In Jordan, the prevalence of CD was found to be 1:2.800, although at that time serological screening for CD has not yet been carried out, and CD was not a common diagnosis among children in Jordan.[5] However, the serological prevalence in schoolchildren in Jordan was later investigated by Nusier *et al* and estimated to be 1:124.[6]

Both pathology and clinical spectrum of CD can vary considerably from severe to subtle, and the clinical expression is not necessarily restricted to the presence of intestinal atrophy.[7] Classical gastrointestinal (GI) manifestations include diarrhea, abdominal bloating, and discomfort.[8] However, many patients have unrecognized CD.[9] due, in part, to the absence of symptoms (silent CD), extra-intestinal clinical presentations,[10] or latent CD which include individuals who have normal jejunal mucosa and no or minor symptoms at least at one time point while on a normal gluten-containing diet.[11] Lack of physician awareness of celiac disease and its associated disorders may contribute to the under-diagnosis of this disease.[12]

Oral manifestations were reported among the extra-intestinal manifestations of CD, these include enamel defects, delayed eruption, recurrent aphthous ulcers, cheilosis, oral lichen planus, and atrophic glossitis.[13] The two main aspects which were extensively investigated in the dental literature as oral manifestations of CD were enamel defects and recurrent aphthus stomatitis and the results in both aspects were controversial.[14,17]

The relationship between enamel defects and CD was first described by Smith and Miller in 1979.[18] Later it was reported in many studies that the prevalence of enamel defects is greater in celiac patients than healthy controls.[19,15] The increased risk to enamel defects was found to be associated with an increased caries incidence.[15] However, no difference in the susceptibility to caries between patients with celiac disease and general population was found by other researchers.[20]

No studies have been reported to investigate dental manifestations of CD in Jordan. Therefore, the objectives of this study were to evaluate whether children and adolescents with CD have higher prevalence of enamel defects and caries risk in comparison with the medically healthy age and gender matched control.

The aim of the study was to investigate the mineralization disturbances in terms of enamel defects and decayed teeth in children and adolescents with mixed and permanent dentition who were diagnosed with celiac disease and compare their oral findings with age and gender matched control group.

Methods

This prospective study was conducted at King Hussein Medical Center (KHMC) on a total 86 patients over a period of one year. Forty-three patients with celiac disease (study group) who were regular attendants of the pediatric gastrointestinal clinics at (KHMC), and 43 healthy dental patients (control group) who attended the general dental practice clinic at the outpatient clinic at the same hospital and selected to match the study group by age and gender.

In both groups, the presence of systemic diseases that may be associated with enamel changes, such as congenital porphyrias, hemolytic anemias, chronic renal failure, phosphocalcic metabolism disorders; premature delivery, mental deficiency, and treatment with drugs that produce pigmentation in either mother or child (e.g., tetracyclines) were excluded from our study. Teeth were also excluded from the assessment when more than two-thirds of the

dental surface was restored, when there were large carious lesions, and fractured.

The dental examination for both groups was carried out by single examiner at the Paediatric dental clinic in the out-patient clinics at the same hospital. Both celiac and control groups were derived from middle social class. Teeth were cleaned up using pumice with a rubber cup, washed and dried thoroughly. A dental unite light used to clearly diagnose their mineralization disturbances. The decayed missed filled teeth (DMF-T) were included. Enamel defects were classified as specific and unspecific according to Wierink *et al*. Specific enamel defects had to be symmetrically and chronologically detectable in all four sections of the dentition whereas unspecific enamel defects were detected as disturbances in hard tissue matrices, including enamel hypoplasia, enamel opacities, molar incisor hypomineralization and enamel discoloration that were not symmetrically and chronologically in all four sections of the dentition.[21]

Enamel defects were diagnosed clinically according to the presence and distribution and graded using the classification of Aine (1990) according to the following criteria: Grade I: Defects in color of enamel: single or multiple cream, yellow or brown opacities. Grade II: Slight structural defects: rough enamel surface, horizontal grooves, shallow pits. Grade III: Evident structural defects: deep horizontal grooves, large vertical pits. Grade IV: Severe structural defects: shape of the tooth may be changed. [22]

The results obtained were expressed as absolute values with corresponding percentages. Differences between the celiac patients and the control group were tested using χ^2 tests and independent sample t –tests. In all of evaluations p values < 0.05 were considered statistically significant.

Results

A total of 43 patients in each of the study and control groups, there were 26 females (60.5%) and 17 (39.5%) males. The mean age of the patients was 13.2±2.85 years for the study group and 13.4±2.74 years for the control group, with a range of 8-18 years in both groups.

Out of a total 86 patients, two (4.6%) celiac patients have shown unspecific enamel defects presented as localized enamel hypoplasia. Four were diagnosed with dental fluorosis and considered to be specific enamel defects. The control group has shown 8 (18.6%) unspecific enamel defects (six with molar incisor hypomineralization defect and two with localized enamel hypoplasia), and 4(9.3%) with specific defects (dental fluorosis). Statistical analysis showed significantly more enamel defects in children with celiac disease compared with the control group (P value = 0.007) (Table I).

Dental defects according to gender showed that males had ten children with grade I, three children with grade II and zero child with grade III, while females had fourteen with grade I, nine with grade II and one with grade III (Fig 1). Table II shows the distribution of enamel defect was more in anterior teeth with a total number of maxillary lateral incisors 69, maxillary centrals incisors 37, maxillary canine 11, and mandibular lateral incisors 4. Whereas the distribution of enamel defects was also observed in posterior teeth with a total number of first and second permanent molars 44 and cusps of first and second permanent premolars 43. The primary teeth in mixed dentition had shown zero enamel defects in both groups. All celiac patients started with a strict gluten-free diet from the first day of their celiac disease were diagnosed, 65.2% of them were compliant before the age of 6 years.

The mean DMFT was 7.15 for the study group while 6.78 for the control group. Caries free subjects comprise of 1 (2.32%) vs. 11 (25.58%) in the study and control groups respectively. The results of this investigation as presented in Table III, revealed that celiac group had significantly more carious teeth (P value 0.03) and less filled teeth (P value 0.001) than the control group; on the other hand the control group had significantly more missing permanent teeth than the study group. The majority of missing teeth were extracted due to orthodontic reasons.

Table I: Grading of enamel defects in celiac disease (CD) and control group

Grade	C, D group No.	%	Control group No.	%
No defects	0		31	72.1
Unspecific defects	2	4.6	8	8.6
Specific defects	4	9.3	4	9.3
Systemic defects	37	86.1	0	0
I	24	64.9	0	0
II	12	32.4	0	0
III	1	2.7	0	0
Total	43	100	43	100%

Sig. (2-tailed) p value= 0. 007

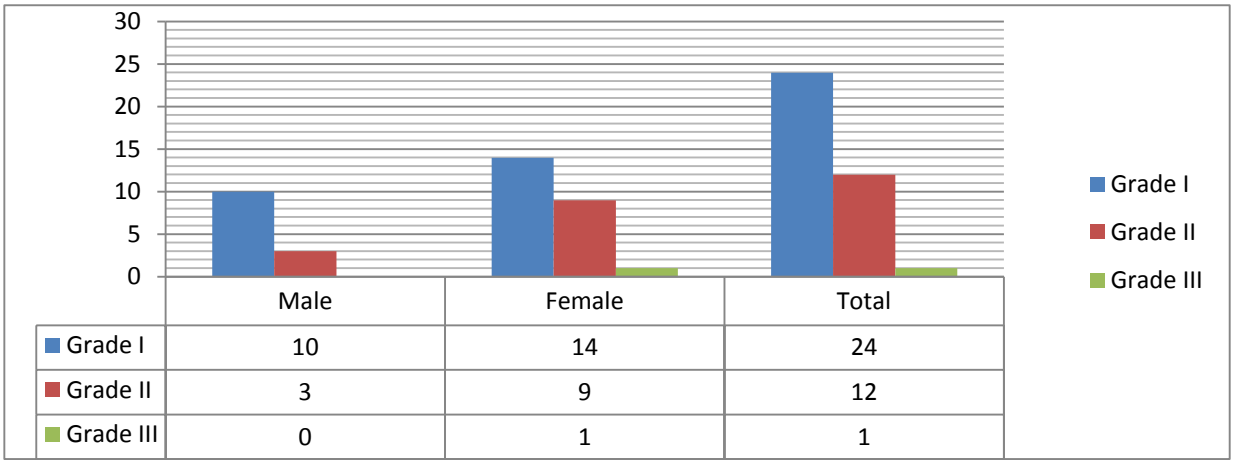

Fig. 1. Gender distribution according to Aine classification

Table II. Distribution of enamel defects in anterior teeth

Permanent teeth	Incisally	Middle 1/3	Cervically	Total
Maxillary centrals	22	12	3	37
Maxillary laterals	11	5	53	69
Mandibular laterals	4	0	0	4
Maxillary cuspid	5	5	1	11
Total				121

Distribution of enamel defects in posterior teeth

Teeth	First permanent premolars	Second permanent premolars	First permanent molars	Second permanent molars	Total
Cusps upper & lower	20	23	34	10	87

Table III. Variations in the DMFT scores for both study and control groups

Variable	Celiac		Control		P-value
	No (%)	Mean±SD	No (%)	Mean±SD	
Decayed	152 (13.74)	3.5±3.4	102 (10.04)	2.4±2.7	0.03 Sig
Missed	2 (0.18)	0.3±0.96	13 (1.37)	0.05±0.3	0.055 NS
Filled	9 (0.81)	1±1.43	43 (3.80)	0.23±0.57	0.001 Sig
Total no. of teeth	1106	26.28±2.14	1130	25.7±2.4	

The compliance of celiac disease patients with gluten free diet (GFD) revealed that 34.8% of the patients were non-compliant, while 65.2% were compliant.

Discussion

The existence of an association between gastrointestinal disorders and oral manifestations had been well documented, i.e. Crohn's disease, celiac disease and ulcerative colitis are occasionally associated with recurrent aphthous stomatitis.[23] In celiac disease, enamel defects in addition to oral ulcerations are considered as essential significant findings. Cheng *et al*. (2010) recommended that all physicians should examine the mouth, including the teeth, which may provide an opportunity to diagnose CD.[24] The authors of this study also recommended to add CD to the differential diagnosis of dental enamel defects and aphthous ulcers. Furthermore the early prevention of CD complications may represent a cost-effective strategy, as the disease is highly prevalent.[25]

Gender distribution in this study (females (60.5%) vs. (39.5%) males) found a female predilection of celiac disease patients. This finding was consistent but less than that found by Sedghizadeh *et al* and Aguirre *et al*, and who found that 65%, and 79% of celiac disease group were females respectively.[17,19]

In consistent with previous literature, the present investigation showed that children with celiac disease had significantly increased risk of dental enamel defects in comparison with control group.[15,19,21] The mechanism of the development of dental enamel defect caused by gluten in patients with celiac disease is still unknown. Nikiforuk and Fraser suggested that a low serum calcium concentration during enamel formation is a specific determinant of enamel defect.[26] The study of Mariani *et al* showed that the human leukocyte antigen complex on chromosome 6 region (HLA-DR3) significantly increased the risk of dental enamel defects, suggesting a genetic cause.[27] Avsar and Kalayci *et al* clearly showed that children with celiac disease had significantly high risk of dental enamel defects compared with the healthy subjects. [15]

In agreement with other researchers,[13,15,21] the distribution of enamel defect in the present study was found more in the incisors and first molars. However, more defects were diagnosed in the maxillary lateral with the defect noticed more in the cervical region. These findings explain that the development of the life cycle of the tooth occurs in the apposition stage, in which their mineralization starts at the age of eleven months after birth and their crown formation completed between 4-5 years.[28] Any insult at this stage will cause mineralization disturbances. This gives a clue that majority of celiac patients were attended to the gastrointestinal clinic when clinical symptoms arise after this age.

In this study, the mean of the decayed teeth was significantly less in the control group than among the patients with CD. This finding contradicts with what reported by Aguirre *et al* and Fulstow who found that patients with CD are less susceptible to caries than the general population, this was explained by a more controlled diet of the celiac children, who do not consume sweets that contain gliadin and who are supposed to avoid eating between meals.[19,20] A previous study concerned with periodontal treatment needs and oral ulceration was conducted on the same patients at KHMC, the results revealed significantly higher plaque scores and poor oral hygiene status in celiac patients compared to control group,[29] which in-turn may explain the significant increase in carious teeth among the celiac group in the present study.

Limitation of the Study

The small sample size of the study group impedes from performing statistical analysis to compare the variables between the compliant and non compliant celiac patients.

Conclusion

It should be pointed out that more than 80% of patients with CD in our setting presented enamel defects of the permanent dentition. These alterations mainly affect the incisors and first molars. The celiac group had significantly more carious teeth and less filled teeth than the control group. We recommend an oral health education program for patients with celiac disease and more dental awareness for the oral manifestation of celiac disease.

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