ORIGINAL RESEARCH

Comparison of Caries and Gingival Status in Patients with Type 2 Diabetes and Healthy Children

Meng-Xing Wang, MD; Tian Xia, MD; Ying Wang, MD

ABSTRACT

Background • Oral health problems often occur in patients with type 2 diabetes (T2D), and the incidences of dental caries and gingivitis increase as blood glucose (BG) levels rise. This work compared caries and gingival status of patients with T2D and healthy children to improve the understanding and attention of patients with T2D to oral health.

Methods • Clinical data of 60 patients with T2D under the age of 10 from May 2020 to September 2022 were retrospectively collected and assigned to the diabetes group. Those 60 healthy children with the same physical examination were collected and assigned to the healthy group. Children in both groups underwent periodontal examination, dental caries examination, and gingival index examination. The prevalence, decayed, missed, and filled teeth (DMFT), caries average (CA), plaque index (PI), gingival crevicular bleeding index (GCBI), attachment loss (AL), and tooth looseness (TL) were observed and compared.

Results • The prevalence of dental plaque (DP) (91.67%) and moderate to severe DP (45%) in the diabetes group was much higher based on those in the healthy group (73.33% and 23.33%) [1.25, 95% CI (0.96, 1.63), $P < .001$]. The prevalence of caries and CA was greatly higher in the diabetes group (75% vs. 21.67%, 2.88 vs. 1.06), and the incidence of gingivitis was higher (63.33% vs. 16.67%) [1.93, 95% CI (1.38, 2.70), $P < .001$]. Meanwhile, the diabetes group exhibited much higher PI (2.31 ± 0.13), GCBI (2.45 ± 0.28), AL (5.62 ± 0.47 mm), and TL (0.85 ± 0.17 mm) and exhibited obvious difference to those in the healthy group (0.92 ± 0.21, 0.86 ± 0.23, 1.65 ± 0.46mm, 0.36 ± 0.08 mm) [3.46, 95% CI (2.33, 5.15), $P < .001$].

Conclusion • The prevalence of dental caries and gingivitis in patients with T2D was higher than those in healthy children. Based on these findings, it is suggested that patients with T2D should be educated and encouraged to prioritize their oral health. Regular dental check-ups, proper oral hygiene practices, and preventive measures, such as professional cleanings and fluoride treatments, should be emphasized. Maintaining optimal blood glucose control is also crucial, as it may help reduce the risk and severity of oral health complications associated with diabetes. (*Altern Ther Health Med.* [E-pub ahead of print.])

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INTRODUCTION

Diabetes mellitus is a group of metabolic disorders characterized by metabolic disorders of carbohydrates, fats, and proteins due to the interaction of genetic and environmental factors and relative or absolute insufficient insulin in the body. Diabetes mellitus can be divided into type 1 (T1D), type 2 (T2D), other types of diabetes mellitus, and gestational diabetes mellitus.[1,2] The basic characteristics of T2D are insulin resistance and functional deficiency of islet ß cells. In the early stage of the disease, insulin resistance is the main feature, supplemented by relatively insufficient insulin. Their insulin levels may be normal or even higher than normal. However, due to insulin resistance, normal or high levels of insulin are not enough to control blood glucose (BG) in the normal range, so more insulin is needed to maintain normal BG.[3,4] However, with the prolongation of the course of diabetes, the function of the islet decreases continuously, and the insufficiency of insulin secretion becomes the main, accompanied by insulin resistance. In terms of clinical manifestations, most patients with T2D are obese at the onset, have insulin resistance, slow onset of high BG, occulted onset, and atypical symptoms, so they are often not diagnosed for many years, so some patients are at high risk of developing macrovascular and microvascular complications.[5,6] Acute complications are rare because T2D still has its own insulin secretion, but ketosis can occur in

cases of infection and other emergencies. The incidence of T2D also varies from population to population. It can occur at any age, including children and adolescents, but it is still more common in people over 40 years of age. Typical clinical manifestations of diabetes include polyuria, polydipsia, fatigue, elevated BG values, weight loss, visual impairment, and gastrointestinal emptying. With the increase in BG, various complications will follow, such as diabetic eye disease, kidney disease, and oral disease,[7,8]

The proportion of patients with T2D with periodontal disease is very high. Studies[9,10] have shown that the risk of severe or refractory periodontitis in people with diabetes is 2 - 3 times higher than that in people without diabetes. The reason for this is that patients with T2D have a relatively weak immune system, poor resistance, changes in the oral environment, improper oral cleaning, and other reasons, so it is easy to stimulate periodontal disease. In addition, periodontal flora, neutrophilic granulocyte function, inflammatory response, tissue healing ability, and other problems can also promote the occurrence of periodontitis. If combined with gum atrophy, loose teeth may also appear. This is because patients with T2D contain a large number of BG components, which can damage the edge of teeth and then appear as granuloma and periodontal pockets. As time goes by, the alveolar bone will be absorbed, and thus, the teeth will become loose and fall out.[11,12] Gingivitis is also a common oral disease in patients with T2D, which is closely related to the poor control of BG. When BG concentration cannot be effectively controlled, oral immunity will be greatly reduced, and gingivitis will be infected by bacteria and fungi. Patients with T2D also develop dental caries, which is not caused by eating sweets. The root cause is mainly abnormal salivary secretion function.[13,14] Those with T2D saliva are much less than the normal population; in this case, the teeth lack enough saliva to clean maintenance, and food debris can damage the teeth. In addition, since the body fluids of patients with T2D are maintained in a state of high sugar for a long time, the sugar content in their saliva will also increase, which can provide favorable conditions for bacteria to breed and thus form dental caries.[15]

In recent years, the incidence of caries in Chinese children has shown an increasing trend. The results of oral health epidemiological surveys[16,17] showed that the prevalence of caries in permanent teeth of 12-year-old children was 34.5%, which increased by 7.8 percentage points compared with 10 years ago. The prevalence of caries in decayed teeth among 5-year-olds was 70.9%, up 5.8 % points from 10 years ago. Decayed teeth can cause a lot of harm.[18] From the local perspective of the mouth, cavities easily cause the retention of food residues in the mouth and then affect the whole oral environment, which easily causes caries to affect the surrounding teeth. Many parents do not let their children develop good and healthy oral hygiene habits, and food residues accumulate on the surface of the teeth and produce bacteria, which can invade the gums and develop gingivitis disease. Dental caries and gingivitis can affect the emergence of permanent teeth and even cause crowding and abnormal dentition development. While previous studies have established an association between diabetes and oral health problems in adults, there is a relative scarcity of research specifically investigating the oral health status of children with T2D. By filling this gap, the study aimed to provide valuable insights into the oral health challenges faced by this vulnerable population and emphasize the need for early intervention and preventive measures. This work retrospectively analyzed the basic clinical data of patients with T2D and healthy children, compared the results of the periodontal examination and dental caries examination, and analyzed the differences in various clinical indicators. It aimed to increase the attention of T2D children and their parents to oral problems caused by diabetes, timely prevention and treatment, and safeguard oral health.

MATERIALS AND METHODS

Ethical statement

The protocol was approved by Children's Hospital's ethics committee affiliated with Capital Institute of Pediatrics, No.1589719. Informed consent and awareness of this study's contents were obtained from the patient's parents or guardians. All the methods were carried out following the Declaration of Helsinki.

Objects

Clinical data of patients under 10 years old with T2D in the Department of Endocrinology of Children's Hospital from May 2020 to September 2022 were retrospectively collected. 60 patients with an average age of 7.7 ± 1.4 years old were set as the diabetes group. The basic data of 60 healthy children with an average age of 7.5 ± 1.6 years in hospital during the same period were selected as the healthy group.

Patients in the diabetes group had to satisfy the following criteria: 1. meeting the T2D diagnostic criteria issued by the World Health Organization (WHO); 2. with the age below 10 years old; and 3. with the course of disease (COD) ≥ 3 months. The patients were excluded according to the below items: 1. those combined with other organic diseases or endocrine diseases; 2. those with a history of hormone drug therapy; and 3. those with a history of drug use that affects glucose metabolism or causes gingival changes, such as immunosuppressants, phenytoin sodium, calcium channel blockers, steroids, etc.

Children in the healthy group were enrolled based on the following criteria: 1. no significant difference between the diabetes group and the children in age, sex, and other basic information; and 2. no endocrine diseases and other pediatric diseases.

Periodontal examination

The purpose of probing was to observe the depth and attachment level of the gingival groove or periodontal pocket; the types and distribution of periodontal pockets; whether the bleeding was observed after probing; contents of

the bag, including the amount and distribution of subgingival calculus; and whether the root forks were involved or proliferated. In addition, the position of the gingival margin should also be examined for gingival receding.

The Community Periodontal Index (CPI) probe (model DE-457, brand CONPUVON) was employed to check for gum bleeding, calculus, and periodontal pocket depth on the index teeth. The exploratory diagnosis was adopted mainly, which was combined with the visual diagnosis. 6 segments were examined from the right upper posterior segment to the anterior segment, the left upper posterior segment, the left lower posterior segment, the lower anterior segment, and the right lower posterior segment. During the examination, the CPI probe was held in pen style with the ring finger as the fulcrum and supported on the hard tissue near the tested tooth. The probe was gently inserted into the gingival groove or periodontal pocket, parallel to the long axis of the tooth and close to the root of the tooth. When detecting adjacent surfaces, the probe was tilted slightly towards the center of the adjacent surface. The subgingival calculus can be felt by moving the gingival groove or periodontal pocket along the buccal (lip) and lingual (palatal) surfaces of the teeth from the distal to the proximal to the proximal. At the same time, gingival bleeding was observed, and the depth of the periodontal pocket was observed according to the scale marks on the probe (3.5, 5.5, 8.5, and 11.5 mm, respectively). CPI probes should be applied with 20 - 25 g of force, as excessive force can cause pain and sometimes puncture gums. Only 16, 11, 26, 36, 31, and 46 index teeth will be examined if the client was 8 years of age or older and under 10 years of age. If the client was under 8 years old, only the calculus and bleeding gums of the 6 teeth were examined, and the depth of the periodontal pocket was not examined.

Dental caries examination

Dental caries examination should be carried out in the way of visual examination combined with exploratory examination under an artificial light source. The examination equipment includes a flat oral mirror and a CPI probe, which can be applied to remove soft dirt from the tooth surface with the aid of a cotton swab if necessary. Visual examination: the tooth was observed carefully under the microscope for any abnormal changes in color. It should note whether there is a black color in the spot gap cleavage area, a change in the color of ink immersion under enamel around, cavity formation, no ink stain discoloration under enamel in adjacent marginal ridge area, and no visible cavities. Probing refers to using a sharp probe to examine a cavity or suspicious area. It should pay attention to whether the tip of the needle can be inserted into the point gap split groove and whether the lateral after force can be hooked in the point gap. If a cavity had formed, the depth and extent of the cavity should be explored. In the case of deep caries, a probe should be used to carefully examine the bottom and pulp corner of the cavity. Percussion should be negative for both shallow, medium, and deep caries. Complications should be considered if percussion pain occurs in caries.

Diagnostic criteria and examination methods

The gingival color and texture were examined for bleeding, gingival itching, swelling, and halitosis. Score criteria were as follows: 0 = gum health; 1 = mild gingival inflammation: the color of the gingival was slightly changed with mild edema, and no bleeding was detected; 2 = moderate gingival inflammation: red gingival color, bright edema, and exploratory bleeding; and 3 = severe gum inflammation: the gums were obviously red, swollen, or have ulcers, and had the tendency to bleed automatically.

Scores were scored according to the thickness of dental plaque but not according to the plaque coverage area. It was adopted to evaluate the oral health status and measure the prevention and treatment effects of periodontal disease. Scoring criteria were as follows: 0 = no plaque in the gingival margin region; 1 = thin plaque on the tooth surface in the gingival margin area, but not visible by visual inspection, and visible DP on the tooth surface scraped with a probe; 2 = medium amount of plaque can be seen at or near the gingival margin; and 3 = large amount of soft scale in gingival sulci or gingival margin area and adjacent surface. PI score = sum of PI score of all teeth / total number of teeth examined.

A blunt periodontal probe was employed for examination. Besides observing the color and shape of the gums, a periodontal probe was also used to probe the gingival groove to observe bleeding. Generally, PI should not be examined before GCBI because the application of stain will affect the identification of gingival crevicular bleeding. It was scored according to the following criteria: 0 = healthy appearance of gingival margin and gingival papilla, and no bleeding after probing gingival sulci; 1 = slight inflammation of gingival margin and gingival papilla and no bleeding after probing gingival sulci; 2 = gingival inflammation, color change, no swelling or hematoma, and punctate bleeding after investigation; 3 = moderate gingival inflammation, color change, mild edema, bleeding after investigation, and blood overflow in the gingival groove; 4 = moderate gingival inflammation, not only color change, and obvious swelling, bleeding after investigation, and blood overflow gingival groove; 5 = colored gingiva, marked swelling, sometimes ulceration, and bleeding or automatic bleeding after probing. GCBI score = sum of gingival index scores for all dental positions / total number of teeth examined.

AL is the result of periodontal support tissue destruction and is an important marker distinguishing gingivitis from periodontitis. The extent of AL can be described by combining the distance between the epithelial crown and the cementum. After measuring the depth of the periodontal pocket, the position of the cementum boundary was explored when the tip of the probe withdrew along the root surface of the tooth, and the distance between the cementum boundary and the gingival margin was measured. The degree of AL was calculated by subtracting the distance from the depth of the pocket. If the two numbers reduce to zero or can't be probed into the cementum, it indicates no AL. If the gingival receding leaves the gingival margin at the root of the enamel

Table 1. The criteria for crown examination

Definition	Criteria
No caries (denoted as 0)	A healthy crown with no dental fillings and no signs of decay was caries-free. The pre-cavity and similar early caries were not recorded because of the unreliable diagnosis.
Crown caries (denoted 1)	Crown caries were marked by marked cavities in the crown, marked sub-enamel destruction, or marked lesions on the bottom or wall of the cavity that can be explored and softened. The patients with temporary fillings, closed cavities, and caries were considered crown caries. A CPI probe should be used to confirm dental decay as determined by the occlusal and buccal-lingual clinics. If there was any doubt, it should not be written down as crown caries.
Filled without caries (marked 3)	A crown with one or more permanent fillings and no decay at any site was marked as filled without caries. Teeth undergoing crown restoration due to caries were also marked with this score.

Figure 1. Plaque detection of patients.

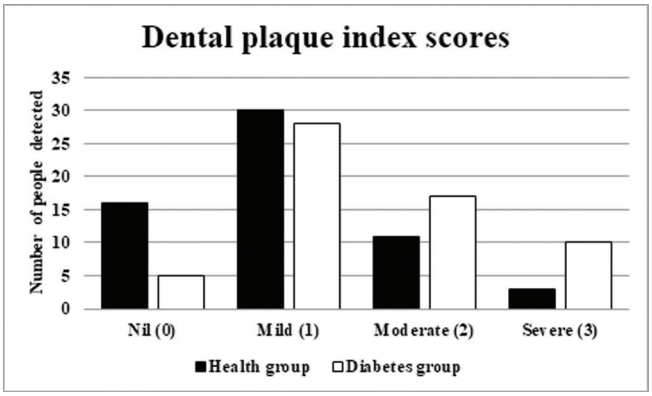
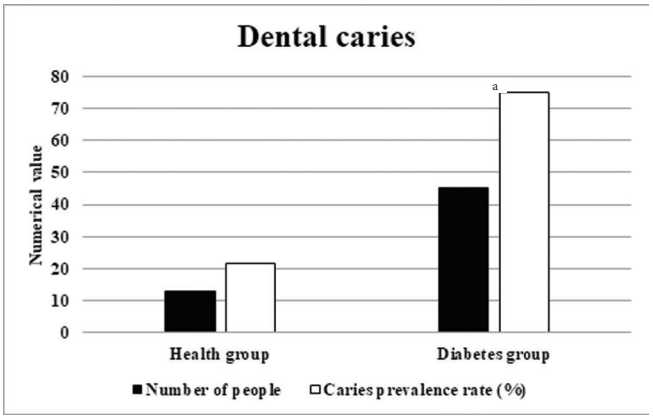


Figure 2. Caries of patients in various groups.



[a]indicated that the caries rate in the diabetes group was obviously different with $P < .05$.

cementum boundary, the two readings should be added together to determine the extent of AL. It was generally believed that the probing depth of the gingival groove in healthy gums is not more than 2 – 3 mm. In gingivitis, the gingival crevicular probe may exceed 3 mm due to swelling or hyperplasia of the gums. When a periodontal pocket was formed, the probing depth was more than 3 mm, and the bottom of the pocket was located at the root of the cementum, indicating that AL had occurred.

TL was generally recorded with degrees I to III and calculated by tooth loosening amplitude. Degree I: the loosening amplitude exceeded the physiological loosening, but the amplitude did not exceed 1 mm. Degree II: the loosening amplitude exceeded the physical loosening degree; the loosening amplitude was 1 – 2 mm. Degree III: the loosening amplitude exceeded the physiologic mobility, and the loosening amplitude was greater than 2 mm. The criteria for crown examination were shown in Table 1.

Caries-related variables were calculated as follows: caries prevalence referred to the frequency of caries in a population during the investigation period. Prevalence of caries = amount of caries/number of patients tested ×100%.

DMFT: caries: decayed, unfilled teeth; the loss of a tooth by decay; a tooth that had been filled with caries. It was calculated with the sum of the number of caries, lost, and filled teeth or the number of tooth surfaces.

CA referred to the average number of caries and lost teeth and dental fillings per person in the tested population, which reflected the severity of caries in the tested population. CA =DMFT/ number of patients tested.

Investigation method

Uniform inspection instruments were employed to avoid errors. Dentists with rich experience in clinical work were selected as investigators for unified and standardized training. All of them passed the standard consistency test, and the survey results were strictly recorded.

Methods for statistics

A database was established, and all experimental data were statistically analyzed by SPSS 20.0. Measurement data were displayed with mean ± standard deviation ($\bar{x} \pm s$), and count data were statistically compared with χ^2. Wilcoxon rank sum and Kruskal-Wallis H tests were used for multiple variables and binary variables, respectively. The measurement data were consistent with normal distribution, and the test was used. $P < .05$ was statistically significant.

RESULTS

Plaque detection of patients in different groups

As can be observed from Figure 1, 73.33% of children in the healthy group and 91.67% of children in the diabetes group have DP around the teeth. The DP detection rate in the diabetes group was higher and exhibited a great difference from that in the healthy group ($P < .05$). Meanwhile, the detection rate of moderate to severe DP in the healthy group and the diabetes group was 23.33% and 45%, showing a great difference with $P < .05$.

Caries of patients in various groups

As demonstrated in Figure 2 below, 13 children in the healthy group had caries, with a rate of 21.67%, while that in the diabetes group was 75% (45 cases). The prevalence of caries in the diabetes group was much higher and exhibited an observable difference from that in the healthy group ($P < .05$).

DMFT in patients

As illustrated in Figure 3 below, the numbers of patients with decayed, missed, and filled teeth in the healthy group were 32, 24, and 8, respectively, with a CA of 1.06, while those were 114, 41, and 18 in the diabetes group, with a CA of 2.88. The DMFT and CA in the diabetes group were much

Figure 3. DMFT in patients.

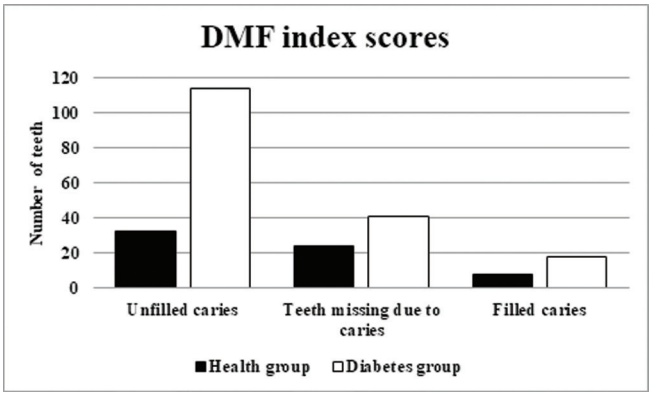
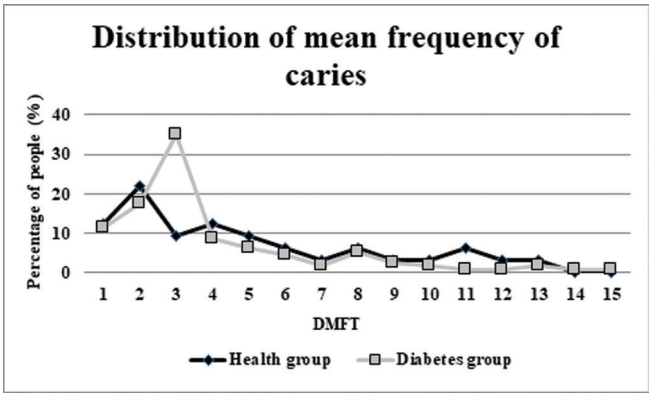


Figure 4. CA frequency distribution of subjects.



higher and showed great differences with those in the healthy group ($P < .05$).

CA frequency distribution of subjects

As displayed in Figure 4 below, among the healthy group of children, the number with 2 caries was the most, accounting for 21.88%. In the diabetes group, the children with 3 caries accounted for the most proportion, accounting for 35.09%. With the increase in the number of caries, the proportion of people decreased gradually.

Caries rates at different dental sites

Figure 5 below illustrates that the maxillary incisor teeth had the highest caries rate, followed by mandibular molars, maxillary molars, and maxillary deciduous cusps, while the mandibular anterior teeth had the lowest caries rate. The prevalence of dental caries in the diabetes group was higher.

Gingivitis in patients

As demonstrated in Figure 6 below, 10 cases with gingivitis were observed in the healthy group, with a prevalence of 16.67%, which was much lower than 63.33% in the diabetes group (38 cases), showing a great difference with $P < .05$.

Relevant clinical indicators of subjects

As revealed in Figure 7 below, the PI (2.31 ± 0.13), GCBI (2.45 ± 0.28), AL (5.62 ± 0.47 mm), and TL (0.85 ± 0.17 mm)

Figure 5. Caries rates at different dental sites.

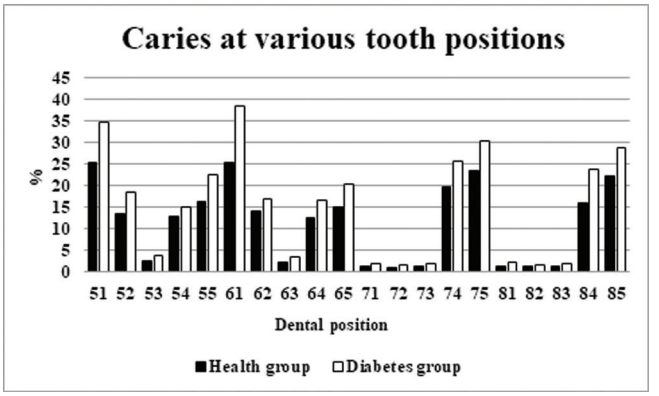
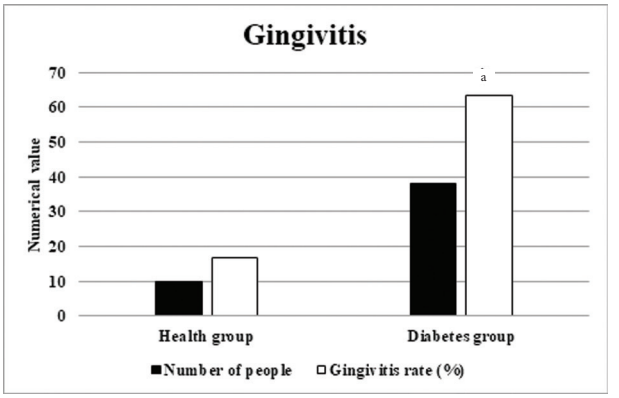
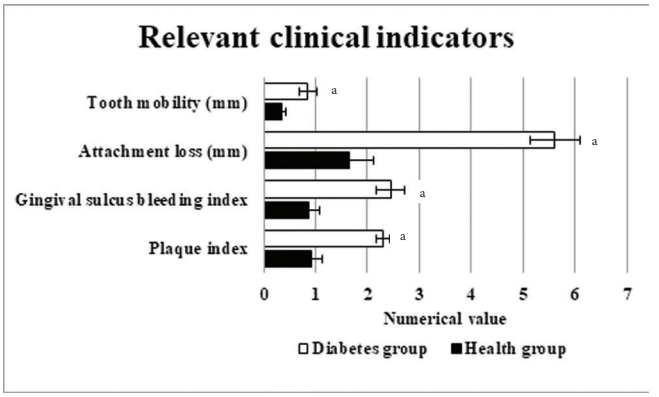


Figure 6. Gingivitis in patients.



[a]indicated a great difference with $P < .05$.

Figure 7. Relevant clinical indicators of subjects.



[a]indicated a great difference with $P < .05$.

of children in the diabetes group were obviously higher and showed great differences with those in the healthy group, which were 0.92 ± 0.21, 0.86 ± 0.23, 1.65 ± 0.46 mm, and 0.36 ± 0.08 mm, respectively ($P < .05$).

DISCUSSION

Caries, which describe holes in the tooth surface or damage to the hard tissue of the tooth, is one of the most common oral diseases, with a high incidence in children. Once caries occurs, it will destroy the structure of teeth, affect children's chewing, eating, and absorption of nutrients and growth and development, and then affect the development of

children's jaw bones. Gingivitis is also a common oral disease in children. Gingivitis is an inflammatory disease limited to the soft tissues of the gums but does not invade the periodontal tissues. The causes of its occurrence include local irritants and systemic factors, including DP, thin gingival epithelium and poor keratosis in children, easily stimulated by bacterial infection or trauma and inflammation, or imperfect oral hygiene. Diabetes is mainly classified into T1D, an autoimmune disease most commonly seen in children and young adults, and T2D, which is characterized by resistance to insulin and can also develop from childhood. In the past, the vast majority of adolescent patients with T2D had type 1 diabetes, which was mostly related to congenital factors. However, in recent years, T2D has been increasing in the adolescent population, and the rate of increase is much faster than that of type 1 diabetes. The younger age of patients with T2D has become a trend, and children of any age are likely to become patients with T2D. For patients with T2D, if no timely treatment measures are taken, diabetes symptoms will be aggravated, often causing complications. In addition to common complications, patients with T2D are prone to dental problems, mainly because BG will increase the glucose concentration in saliva, providing rich nutrition for bacteria in the teeth, resulting in bleeding gums, redness, and swelling. Dental caries, gingivitis, or progressive AL and alveolar bone resorption may also occur, leading to tooth loosening and, in severe cases, tooth loss.[18,19]

In this study, clinical data of patients with T2D under 10 years old were retrospectively collected as the diabetes group, and basic data of 60 healthy children were collected as the healthy group. Subjects in both groups underwent a periodontal examination and dental caries examination, as well as a gingival index examination. PI, GCBI, AL, and TL of the two groups were observed and compared. The results revealed that DP (91.67%) and DP (45%) in the diabetes group were observably higher than those in the healthy group (73.33% and 23.33%). The rates of caries (75%) and CA (2.88) in the diabetes group were much higher, 21.67% and 1.06 in the healthy group. In this respect, Beheshti et al. (2021) [19] also carried out a study to investigate the relationship between diabetes and dental caries in American adolescents. The results showed that those with elevated BG and HbA1C had significantly increased rates of tooth decay compared to healthy subjects. Teens with diabetes were more than twice as likely to have cavities compared to non-diabetic teens. Similarly, patients with T2D were more likely to develop cavities than non-patients with T2D. This study highlights the need for continued cross-professional collaboration to address oral health issues in adolescents with pre-diabetes and diabetes. The results herein were consistent with it. The occurrence of dental caries in patients with T2D is mainly related to reduced saliva secretion. The main clinical manifestation of patients is the simultaneous occurrence of dental caries in multiple teeth. In addition, patients are also very sensitive to hot and cold stimulation and are prone to dental pain in severe cases. The data showed that maxillary deciduous incisors and mandibular deciduous molars were more common in dental caries, followed by maxillary deciduous molars and maxillary deciduous incisors, mandibular deciduous incisors, and maxillary deciduous incisors. In addition, this work revealed that maxillary incisor teeth had the highest rate of caries, followed by mandibular molars, maxillary molars, and maxillary deciduous cusps, and mandibular anterior teeth had the lowest rate of caries. The prevalence of caries at all dental sites in patients with T2D was higher than that of children with health conditions. This suggests that the order of placement is slightly different across surveys but roughly the same. Among the healthy group of children, the chance of gingivitis was 16.67 percent, significantly lower than the diabetes group's 63.33 percent. The PI (2.31 ± 0.13), GCBI (2.45 ± 0.28), AL (5.62 ± 0.47 mm), and TL (0.85 ± 0.17 mm) of children in the diabetes group were significantly higher than those in the healthy group Children (0.92 ± 0.21, 0.86 ± 0.23, 1.65 ± 0.46 mm, 0.36 ± 0.08 mm), the difference was statistically significant ($P < .05$).

Everyone has some calculus, but patients with T2D have more calculus. The main reason is that due to the continuous increase of BG and poor control, the oral health condition will gradually deteriorate, the increase of calculus deposition will stimulate the periodontal tissue, and it is accessible to local inflammation. The most common dental problems in patients with T2D are gingivitis and periodontitis. When BG continues to increase, the sugar concentration in saliva increases, and gingival congestion, edema, and bleeding will lead to tooth loosening displacement and periodontal abscess. Tooth loosening progresses slowly, but there will be many teeth loosening one after another. If the degree of loosening gradually increases, the degree of loosening is very large in the later stage of the disease; it is easy to make the teeth fall out, and the chewing function will be lost.[15] Luong et al. (2021)[20] suggested that although periodontitis may lead to insulin receptor desensitization, diabetes may increase the expression of inflammatory cytokines in gingival crevicular fluid and activate osteoclasts through the production of nuclear factor κ-β ligand-receptor activators, leading to bone resorption. However, the link between the two disease processes is unclear, so they explored the pathophysiology and molecular mechanisms of T2D and periodontitis. The oral microbiome composition of T2D and periodontitis shifted to a microecological imbalance, which favored bacterial pathogens. Changes in the composition of the oral microbiome may activate host inflammatory responses and lead to irreversible oxidative stress, marked by the activation of pro-inflammatory immune activity of inflammatory cytokines. Therefore, the future drug targets are multi-factorial. Even if these are two different diseases, the appropriate program can be selected for co-treatment to achieve the best effect. Santamaria et al. (2019)[21] also evaluated the inflammatory changes of gum tissue and alveolar bone in rats with diabetes and periodontitis through animal experiments. The results herein suggested that the number of inflammatory cells and the expression of inflammatory markers such as IL-6, TNF-α, and TGF-β1 were increased in rats with diabetes and periodontitis. The inflammatory response was altered by diabetes and may be aggravated by periodontitis.

In conclusion, tooth complications in patients with T2D include loosening, tooth caries, and gingivitis. When suffering from diabetes, in order to prevent other complications and maintain their own more normal state of life, it is recommended that patients have regular physical examinations, measurements of BG and urine sugar, and actively do preventive work. It can exercise moderately to enhance your physical fitness, regulate fat metabolism, change bad eating habits, and not eat food with high sugar and high calories. Diabetes affects various organ systems in the body, leading to microcirculatory and neuropathy. The microcirculatory system that supplies teeth is also affected, leading to gum atrophy. Moreover, diabetics themselves have low immunity and are prone to concurrent infection, leading to oral diseases such as gingivitis and oral ulcers. Therefore, it is necessary to actively control BG to reach the standard smoothly, pay attention to maintaining oral cleanliness in daily life to prevent the occurrence and development of various oral diseases and go to the hospital regularly for periodontal inspection and timely removal of dental stones and DP attached to the tooth surface, which is of great help to prevent dental diseases. Patients with T2D are usually advised to have their teeth checked every six months and to have their teeth cleaned if necessary. Oral disease is a chronic disease, and most of the early lack of conscious symptoms is easy to ignore. Once symptoms appear, such as pain and swelling, the disease is often serious, so it is necessary to achieve the purpose of early detection through regular oral health examination. Generally, children 0 - 5 years of age are checked every 2 - 3 months, children 6 - 8 years of age every six months, and children over 9 years of age can be checked annually. Regular dental check-ups can prevent disease early, protect teeth, help detect early caries and gingivitis, and provide early solutions for parents.

The clinical implications of these findings are significant. Dentists and healthcare providers should be aware of the increased risk of oral health problems in patients with T2D, particularly in children. Regular dental examinations, early detection of caries and gingivitis, and appropriate preventive and therapeutic interventions are crucial in managing the oral health of individuals with T2D. Moreover, patient education and oral hygiene instructions should be emphasized to promote good oral health practices.

Future research in this field should explore the underlying mechanisms linking T2D and oral health problems. Investigating the specific factors contributing to the higher prevalence of caries, gingivitis, and periodontal disease in patients with T2D can provide insights into potential preventive and treatment strategies. Longitudinal studies can help establish a clearer understanding of the temporal relationship between T2D and oral health problems and assess the impact of interventions on oral health outcomes in this population.

Furthermore, research focusing on interventions and oral health promotion programs tailored specifically for children with T2D is warranted. Identifying effective preventive measures and interventions that address the unique challenges faced by this population can help improve their oral health outcomes and overall well-being.

CONCLUSION

In this study, the caries and gingivitis status of T2D children and healthy children were retrospectively compared. The results of various indicators showed that dental caries and gingival conditions were more serious in diabetic children than in healthy children, and the degree of tooth damage in patients with T2D was often more significant than that in patients without T2D. Attention should be paid to early treatment as soon as possible to prevent oral diseases. The deficiency of this work was that the sample source was single and could not represent all T2D children and healthy children. In the future, this topic will be further improved to provide a reference for T2D and healthy children's oral health monitoring and oral health knowledge popularization.

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