

Oral Health Status among Children with Down Syndrome in Dubai, United Arab Emirates

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ABSTRACT

Objectives: The purpose of this study was to assess the oral health status in Down syndrome (DS) children in Dubai, United Arab Emirates.

Materials and Methods: A total of 106 DS children (mean age = 9.3 ± 2.8) and 125 healthy children (mean age = 11.7 ± 4.4) were recruited from both special needs centers and private/public schools in Dubai. A dental examination for decayed-missing-filled teeth (DMFT) in deciduous dentition/DMFT in permanent dentition indices, simplified oral hygiene index, calculus index (CI), were carried out. In addition, occlusal, dentofacial, soft-tissue abnormalities, and erosion were assessed. Statistical analysis was conducted using SPSS for Windows, version 20.0 (SPSS Inc., Chicago, IL, USA).

Results: The mean number of DMFT in DS children was significantly higher than that in healthy children. DS children in the primary dentition group had higher restorative index and Met Need Index scores than the control group. On the other hand, CI was found to be significantly higher among children with DS compared to healthy controls ($P < 0.004$). DS children had a significantly higher proportion of open bite and other occlusal problems. Class III molar angle malocclusion was significantly higher in DS (66%) compared to controls (11.2%). Erosion was significantly higher among DS children compared to healthy control (34% vs. 15.3%).

Conclusions: DS children in Dubai had higher caries rate compared to healthy children. DS group received more restorations and dental treatment compared to the control group. More to add, DS children had significantly more calculus, erosion, and malocclusion problems.

KEYWORDS: Dental caries, Down syndrome, malocclusion, oral health problems, special needs, trisomy 21

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INTRODUCTION

Down syndrome (DS) is a syndrome named after John Langdon Down, a British doctor who first described it in 1866.^[1] DS or Trisomy 21 “is a genetic disorder caused by a trisomy of chromosome 2,^[2] which is an extra chromosome No. 21.” An atypical separation of chromosomes during cell division results in the affected persons having three chromosomes.^[3,4]

DS patients have specific characteristics in the head-and-neck area. The most noticeable characteristics include brachycephaly, thin cranium with delayed closure of the fontanelles, fine and

thin hair, frontal bossing, blocked tear ducts, small and wide nasal bridge, hypotonia of muscles with predisposition to retain the mouth open and the tongue protruded, deficiency in the midface, short neck, abnormally sized or missing earlobes, loss of hearing ability that might be a resultant of fluid buildup in the

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middle ear and atlantoaxial instability that might lead to dislocation.^[1,3]

In the USA, of all abnormal chromosomal conditions, DS is the most commonly reported.^[5] The incidence of DS in the USA is about one in every 700 live birth.^[6] In the Middle East and North Africa region, the reported incidence of DS in Dubai is the highest. The incidence is reported to be 1 in every 319 live birth in the United Arab Emirates (UAE) citizens and 1 in every 602 live births in expatriate children.^[7]

The advent of better health-care practices leads to better life expectancy in DS individuals.^[1] DS population are better integrated with their counterparts in schools, work, and community.^[1,5] The higher life expectancy resulted in higher needs for dental care for this special needs group and therefore, all medical health professionals should be aware of all peculiar features of DS individuals that might affect the provision of their oral health care.

The prevalence of periodontal disease in DS patients is reported to be significantly higher than the normal population. The compromised immune system with a decrease in the number of T cells increases the liability of DS individuals to infections including periodontal disease.^[5] Other reported orofacial features reported to include: “Hypoplasia of teeth, supernumerary teeth, atypical patterns of eruption, bruxism, ectopic eruption, macroglossia, high arched palates, prognathism, open bite, fissured tongues, angular cheilitis, smaller permanent dentition, and larger deciduous dentitions.”^[1,3,8] In addition to that DS children are commonly reported to have congenitally absent.^[1] The dental morphology is also affected particularly shovel-shaped incisors, missing or reduced marginal ridges, nipple appearance of the canine tips, and wrinkled occlusal surfaces of molars.^[1]

The cognitive abilities of DS individuals vary from mild-to-moderate IQ impairment. With some incidence of delay in expressive language.^[5] The latter issue might pose challenges for these individuals to access health-care services.^[9]

In general, increased prevalence of periodontal disease and poor oral hygiene are reported in special health-care needs.^[10] Furthermore, reports on special needs people indicated increased prevalence of caries, and lower levels of care.^[11] The treatment provided for these children is lower than their normal counterparts.^[10] Within the same families, DS children were reported to be less likely to visit the dentist annually for both restorative and preventive care compared with their healthy siblings.^[12]

The US surgeon general’s report.^[13] stated that “dental caries is the most common infectious disease of

childhood.” In addition, it is considered to be the primary reason for tooth loss in special needs patients.^[10] The reports on the caries prevalence in DS individuals vary worldwide.^[8] In Jordan and Portugal, DS children have lower caries prevalence than healthy children.^[8] Conversely, in Saudi Arabia, DS patients were reported to have higher caries prevalence.^[14] A systematic review by Dets *et al.* showed no difference in caries prevalence between DS children and normal children was reported.^[8] The reasons for this controversy in the prevalence of caries in DS children are unclear and might be affected by several factors across the world.

Studies conducted in the UAE reported higher prevalence of caries and periodontal disease.^[11,15] As Dubai has the highest DS incidence in the region,^[7] oral condition of the DS children in Dubai in particular, and the UAE in general must be investigated to get baseline data and guide the authorities in the provision of proper oral health care for this group.

The purpose of this study was to assess the oral health status among children with DS and in controls in Dubai, UAE. There is little information on the status of oral health and the dental treatment needs among DS children in Dubai, UAE. This data are very important to develop interventions to improve the oral health of this group of special needs children.

MATERIALS AND METHODS

A quantitative case-control study design was used to compare the oral health characteristics of DS children and healthy control in Dubai. The study group consisted of DS individuals from the special needs centers located in Dubai. The controls were healthy children living in the same geographic region. An attempt was made to match both controls and DS groups in age and sex. Both groups were between the ages of 4 and 18-year-old and were chosen by a stratified random sampling technique.

The sample size calculation was based on the Cochran equation of sample size. Our calculation depended on the prevalence of caries among DS in a comparable community in the region. Using the data reported in previous study in the UAE.^[11] A 20% of the nonresponse was added to the sample size calculated to yield the working sample size, which was 82. The total sample size projected was 82 DS and 82 healthy children.

This study was conducted in full conformance with principles of the “Declaration of Helsinki,” and good clinical practice. The ethical approval was obtained from the Research Ethics Review Committee in Dubai Healthcare City on May 5, 2014. In addition, approval was obtained from the Ministry of Social Affairs in Dubai

to examine DS children in the special needs centers. The examination was conducted by two principal investigators calibrated and tested for intra- and inter-examiner reliability with kappa statistical analysis of 80% agreement. Data were collected using standard coded form, portable dental chair, artificial light, disposable mouth mirror, and a World Health Organization (WHO) ball-ended dental probe.^[16] Uncooperative children were excluded.

The following indices were used: (1) Angle malocclusion classification^[17] and primary molar terminal plane relationship,^[18] (2) Caries Index: decayed-missing-filled teeth (DMFT) in primary dentition and DMFT in permanent dentition using the WHO criteria,^[19] (3) Met Need Index (MNI), an indication of treatment received by an individual, that is, M + F/decayed-missing-filled; and (4) restorative index (RI) which reflects the restorative care of those who have suffered the disease is measured by F/F+D percent as described by Jackson.^[20] In addition, the simplified Oral Hygiene Index (OHI) of Greene and Vermillion^[21] was used for assessment of periodontal status of permanent dentition while the presence of gingivitis, calculus, and debris was marked for the primary dentition. Finally, the erosion index by Walker *et al.*^[22] was used to assess the presence of erosion.

The collected data were analyzed using computerized Statistical Package for the Social Sciences (SPSS) for Windows, version 20.0 (SPSS Inc., Chicago, IL, USA). Descriptive statistics were performed for a general description of the data. Chi-square and exact Fisher test were performed to examine differences between categorical data and *t*-test was performed to compare continuous variable. The level of statistical significance was set at 5%.

RESULTS

STUDY SAMPLE CHARACTERISTICS

Children with DS had an average age of (9.3 ± 2.8), where the control group had an average age of (11.7 ± 4.4). For gender distribution, 63 (59.4%) of children with DS were males compared to 55 (44%) males in the control group. Nonlocals had more DS children than locals, 60 (56.6%) and 46 (43.4%), respectively, with $P < 0.001$. The dentition type distribution was comparable between children with DS and the healthy control. Twenty-two DS children (20.8%) were in primary dentition stage, 31 (29.2%) in permanent dentition, and 53 (50%) in mixed dentition, while the control group the numbers were 13 (10.4%), 36 (28.8%) and 76 (60.8%) respectively.

DENTAL CARIES

In general, the occurrence of dental decay in children with DS and healthy controls was equal as it was

57.6% (57/106) in the DS group, whereas for the healthy controls was 57.6% (72/125). Table 1 demonstrates the caries status of the sample population. There was a statistically significant difference in caries experience among DS children compared to the healthy controls in permanent teeth as measured by DMFT ($P = 0.021$). The mean numbers of the decayed component of DMFT in DS children were significantly higher than that in healthy children (2.73 ± 0.22 vs. 1.65 ± 2.46 , $P = 0.01$). However, the difference in primary teeth (mean DMFT) was not statistically significant ($P = 0.918$).

In regards to the treatment of the decayed teeth restorations, children in the DS group received more treatment than their controls in all age groups; however, this was not shown to be statistically significant.

The restorative care and the treatment received in both study groups were measured by the RI and the MNI as shown in Table 1. Surprisingly, DS children in the primary dentition group had higher RI and MNI scores (RI = 27% and 40%, respectively).

ORAL HYGIENE STATUS

Simplified OHI-score was calculated for children in the mixed and permanent dentition and was not significantly different between children with DS compared with the controls (1.36 ± 1.16 vs. 1.42 ± 1.14). Calculus Index (CI) was found to be significantly higher among children with DS 0.25 ± 0.52 compared with healthy controls 0.07 ± 0.27 ($P < 0.004$). The proportion of gingivitis was found to be comparable between children with DS compared with that of the healthy controls 65.4% and 70.4%, respectively ($P = 0.252$).

OCCUSAL ANOMALIES

Several occlusal anomalies were measured in both groups such as open bite, deep bite, crossbite, scissor bite, anterior spacing, posterior spacing, and traumatic

Table 1: Caries status (Decayed, Missing, Filled teeth), restorative index, and Met Treatment Index (mean values in both primary and permanent teeth)

	Controls (n=112), n (%)	DS (n=84), n (%)	P
Primary dentition			
dmft index	2.76±2.93	3.42±4.15	0.918
RI*	2.52	27	-
MNI**	2.54	40	-
Permanent dentition			
DMFT index	2.16±2.89	3.32±4.62	0.021
RI*	11.76	26.81	-
MNI**	23.6	35.6	-

*RI=F/F+D, **MNI=M + F/DMF. DMFT=Decayedmissingfilled teeth, RI=Restorative index, MNI=Met Need Index, DS=Down syndrome

dental injuries. The results are summarized in Figure 1. Regarding molar angle classification, the proportion of Class I was prevalent among healthy controls 68 (54.4%) compared to children with DS 4 (3.8%) as Class I. The same outcome applied to Class II, as the proportion of Class II was lower among children with DS 7 (6.6%) compared with proportion of healthy controls with Class II, 28 (22.4%). Conversely, proportion of Class III was found higher among children with DS compared to the healthy controls 70 (66%) and 14 (11.2%), respectively ($P < 0.001$). On the other side, the primary molar relationship in DS individuals was found to have higher occurrence of mesial step relationship compared to the control group (13.3% vs. 4%).

DENTOFACIAL ANOMALIES

Children with DS demonstrated higher proportion of high shovel-shaped incisors, high arched palate, microdontia, nipple appearance of the canine tip, tongue thrust, and lymphadenopathy compared with that among healthy controls [Figure 2]. A single case of transposition of canine was found among DS group.

ORAL SOFT TISSUES

As shown in Table 2, children with DS had significantly higher proportion of all the conditions listed. The controls scored 0 for all the listed conditions, except macroglossa where only one control child had macroglossa compared with 49 (46.2%) in the DS group. A total of 72 (67.9%) DS children had fissured tongue.

EROSION

The severity of erosion was significantly higher among DS children compared to healthy control ($P = 0.006$). The proportion of DS children with erosion was 34% versus 15.3% in the control group. The percentage of DS children with erosion into enamel only was 19.8% (21/106) compared to 11.3% (14/125) in the control group. The percentage of erosion into enamel and dentine was 12.3% (13/106) in DS children versus 4% (5/125) in healthy children. In addition, the

percentage of severe erosion, which is into enamel, dentine, and pulp, was 0% in the control group compared to 1.9% (2/106) in DS group [Figure 3].

DISCUSSION

As the life expectancy of DS individuals is improving and the prevalence is increasing.^[1] It is of a great benefit to understand the oral health problems experienced by this group. Since there is no central DS registry data

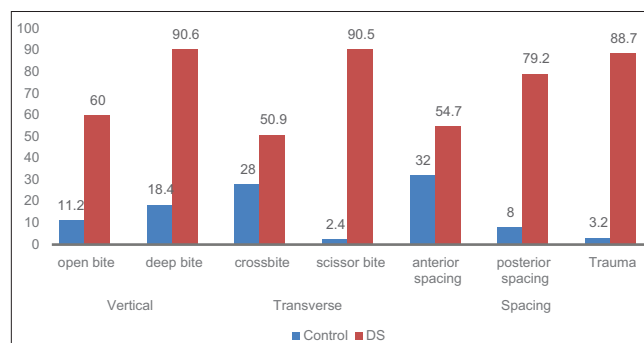


Figure 1: Occlusal anomalies and traumatic dental injuries in Down syndrome and control children

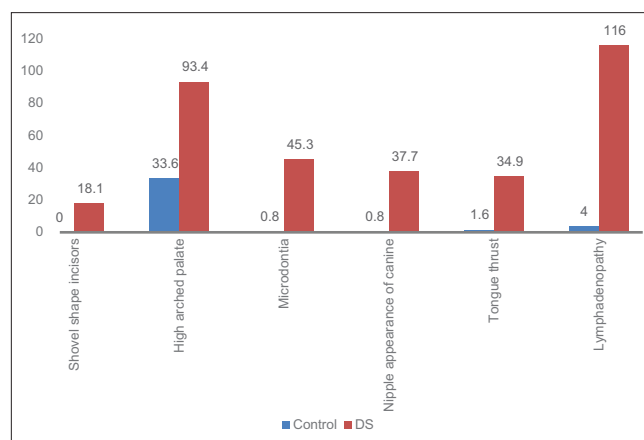


Figure 2: Dentofacial anomalies in Down syndrome children and control

Table 2: Oral soft-tissues findings in Down syndrome and control children

Condition	Control Nr (%)	DS Nr (%)	P
Atrophy of tongue	0	8 (7.5)	0.002
Geographic tongue	0	9 (8.5)	0.001
Fissure tongue	0	72 (67.9)	0.001
Irritation fibroma	0	1 (1)	0.454
Angular cheilitis	0	23 (21.7)	0.001
Macroglossia	1 (0.8)	49 (46.2)	0.001
Ulcer	0	3 (2.8)	0.096
Trauma to soft tissue/lip	0	3 (2.8)	0.096
Drooling	0	25 (23.6)	0.001

DS=Down syndrome

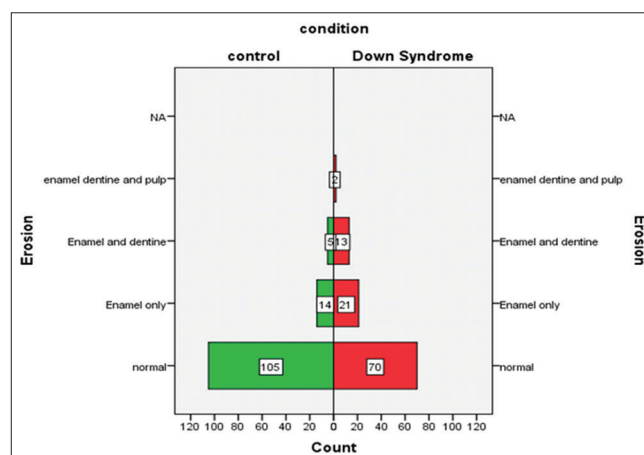


Figure 3: Erosion severity in Down syndrome and control children

in the UAE, particularly in Dubai, an accurate estimate of the percentage of DS is difficult. The only generated data suggests that DS incidence in Dubai was 1 in every 319 live birth among UAE nationals, and 1 in 602 live births among nonnationals,^[7] which is the highest in the Middle East region. This might be attributed to increased maternal age and consanguineous marriages. This study provided an opportunity to assess the oral health problems among DS children in Dubai who are enrolled in special needs centers.

A quantitative case-control study design was used to compare the oral health characteristics of DS children and healthy control in Dubai. The sample used in this study presented a fair distribution with respect to age and gender. The males (63 out of 106, 59%) in the DS group were more than females (43 out of 106, 41%), which might reflect the higher occurrence of DS in males as reported by a study conducted in the Sharjah city, UAE and other parts of the world.^[11] In regards to the geographic distribution, the special needs centers were from different areas in Dubai and the control group was matched accordingly. This wide distribution allowed us to cover Dubai as a whole city instead of a particular area. A sample size calculation was done before data collection to make sure a sufficient number of children was included. This might have strengthened the validity of the results and made them applicable to the neighboring cities in the UAE. A total of 106 DS individuals along with 125 controls were examined which exceeded the calculated sample size.

DENTAL CARIES

This current study used the DMFT/DMFT index to detect dental caries, according to the WHO standards.^[19] This method is reported to be efficient to detect dental cavities, but not the noncavitated lesions, which can be diagnosed using the International Caries Detection and Assessment System (ICDAS).^[23] Of course, the inclusion of noncavitated lesions, and the use of the International Caries Detection and Assessment System would give a better idea of disease prevalence which means a better understanding of treatment needs.^[24] However, the dmft/DMFT index was used in this study due to the large sample size and its objectivity. In addition, the WHO criteria of caries diagnosis^[19] are still the standard in epidemiological studies and its use allowed comparison of this study results with national and international studies. Furthermore, using radiographs to detect noncavitated lesions for screening purposes would neither be ethical nor practical.

In this study, the mean number of the decayed component of DMFT in DS children was significantly higher than the value in healthy children (2.73 ± 0.22 vs.

1.65 ± 2.46 , $P = 0.01$). These findings are consistent with a previous study conducted in Sharjah.^[11] In Sharjah, the mean number of the decayed component of DMFT in DS patients was almost twice as high as that in healthy controls (13.2 ± 0.84 vs. 7.4 ± 3.94), which is even higher than the finding in the current study.

The prevalence of caries in DS children varied in the literature and the findings are conflicting. Some studies reported lower caries rate,^[8] while others reported either similar or higher caries rates.^[11,15] Today, most DS children are raised at home and only attend special needs schools and might have higher exposure to cariogenic foods. Furthermore, lower caries rate in DS children is explained to be as a result of several factors such as increased spacing between the teeth, delayed eruption of the teeth, possible different salivary chemical content, hypodontia, microdontia, and flatter teeth due to bruxism.^[25] In a recent study, Scalioni *et al.* reported that the reduced dental caries experience in DS children cannot be attributed to lower salivary *Streptococcus Mutans* densities.^[26]

In a systematic review conducted by Moreira *et al.* in 2016 reported that the results of their final sample of 13 studies. A lower caries experience in DS patients was reported in ten studies and in three there were no differences in caries experience.^[27]

A high caries rate among DS children in Dubai is not surprising because they seem to follow the normal caries pattern reported by a recent dental survey among healthy children. The latter survey in the UAE found that the prevalence of dental caries among healthy schoolchildren was 76.1% and the average DMFS score was 10.2.^[28] This high prevalence of dental disease in UAE might be attributed to cultural factors,^[29] such as strong family cohesion and the involvement of extended family members in taking care of the children, high sugary diet, and lack of dental visits.^[30] Likewise, a study conducted in neighboring countries also reported a high decay rate among DS children and young adults.^[31]

The MNI and RI in the DS children were higher compared with healthy control children [Table 1]. This means that the restorative treatment needs of the studied DS children in the present study were more addressed compared to the control group. These values were in disagreement with the results found in Sharjah and other studies,^[11,12] as the MNI and RI were lower for the DS sample. This difference could be because DS children in Dubai might have better access to dental clinics than those in Sharjah. Furthermore, The Ministry of Health in Dubai provides free dental treatment for special needs children who are holders of a special needs medical card. Moreover,

the children recruited for this study were all in special need centers which might imply a high-socioeconomic status of their parents making them able to afford dental treatment. In addition, it has been suggested that due to the nature of their complex medical condition, DS parents tend to be more concerned about their children's dental health and seek dental advice earlier.^[25] However, the fact that we were unable to recruit DS children who are not in the special need centers might bias this finding because we are not aware of their dental health status and treatment needs.

This study was able to demonstrate that despite the higher percentage of treatment received among DS children; they still had a higher caries compared to control children. The authors suggest that several reasons might be attributed, namely, traditional habits, absence of parental knowledge on the significance of prevention and regular dental visits, parental negligence, long waiting lists for dental treatment, especially in the public hospitals, and insufficient general anesthesia facilities and children dental specialists often needed for the comprehensive treatment of DS patients. Further studies into the aforementioned factors and their possible contribution, is necessary to help shed some light on this dilemma.

ORAL HYGIENE STATUS

Since periodontal disease is a significant oral health problem in people with DS, it is very important to understand the status of oral hygiene in this population. CI was found to be significantly higher among children with DS. The higher calculus in DS children might be attributed to the high calcium content in their saliva^[2] and not necessarily due to poor oral hygiene as reported by Porovic *et al.* where 43.9% of DS children had very good oral hygiene and 33.3% had good oral hygiene.^[32]

The proportion of gingivitis was found to be 65.4%, although less than the control group, gingivitis was present in more than half of the DS sample. It has been reported that gingivitis in DS develops more rapidly and is more extensive around deciduous teeth compared to healthy children.^[33] In addition, DS patients have other factors that aggravate the periodontal disease such as abnormalities in host defense, particularly leucocyte response, defective connective tissue, and altered vascularization.^[34] Periodontal disease is of a great concern in DS patients because it has a progressive pattern, and children can present with marginal gingivitis, gingival recession, advanced periodontitis, and pocket formation. Pocket formation has been reported in 36% of DS children below the age of 6 years.^[35]

The hallmark of managing periodontal disease in DS individuals is prevention. A comprehensive preventive

dental program is needed to promote better oral hygiene, prevent the development of periodontal disease, and halt its progression. DS children must be always screened for periodontal disease and early, aggressive treatment is needed. They may be needed to be seen more often for scaling and root planning. A recent systematic review concluded that children with physical and intellectual disabilities need early and regular dental care to prevent and limit the severity of the pathologies observed.^[36]

OCCUSAL ANOMALIES

DS children have unique occlusal and dentofacial anomalies that are present frequently and might lead to improper functioning and add up to the complexity of their condition. The dentofacial anomalies findings of this study are in agreement with the study conducted by Macho *et al.*^[25] More to add, the DS sample studied in the Sharjah, UAE had similar findings.^[11]

It is well-established that Class III malocclusion is more common in DS children, due to underdevelopment of the midface and mandibular prognathism.^[25] This typical malocclusion prevalence was confirmed in our study. In addition, the most prevalent primary molar relationship in DS individuals was found to be the mesial step relationship compared to the control group (13.3% vs. 4%). Due to the small number of participants with primary dentition, no statistical significance was found in the latter finding. This mesial step relationship explains the Class III malocclusion later on in DS children, as mesial step relationship may progress to a Class III during the molar transition with continued mandibular growth.^[37]

DENTOFACIAL ANOMALIES

In this study, DS individuals had remarkably increased frequencies of shovel-shaped incisors, high-arched palate, microdontia, nipple appearance of the canine tip, tongue thrust, and lymphadenopathy compared to controls. These findings were also reported in the literature along with other findings such as dentinogenesis imperfecta, taurodontia, peg-shaped teeth, impacted teeth, dens evaginatus, and talon cusp.^[11,25]

ORAL SOFT TISSUES

DS children in this study had significantly higher proportion of geographic tongue, atrophy of the tongue, fissure tongue, irritation fibroma, angular cheilitis, macroglossia, ulcers, trauma to soft tissues, and drooling compared to healthy controls. Fissured tongue was found in 67% of DS children in this study. Fissured tongue is a nonpathological variation of the normal tongue and often seen in DS individual. Fissured tongue is asymptomatic, often associated with geographic tongue, and the only clinical relevance it plays is that it acts as a bacterial reservoir and causes glossitis.^[38]

Other findings related to the tongue in DS individuals is relative macroglossia, where the tongue gives the impression of being large due to muscle weakness and low position in the mouth.^[38] Macroglossia within DS individuals in this study was seen in 46.2%, which is similar to the incidence in other studies (11%–60%).^[11,39]

EROSION

Tooth wear as a result of acidic and chemical insult to the teeth are commonly noticed in DS children. Erosion in DS children is related to the fact that 13.8%–59% of DS children suffer from gastric dysfunction such as gastroesophageal reflux and vomiting.^[40]

In our study, the severity of erosion was significantly higher among DS children compared to healthy control ($P = 0.006$). The proportion of DS children with erosion was 34% versus 15.3% in the control group. Another study also found that erosion was significantly higher in DS individuals than the normal population.^[41]

STUDY LIMITATIONS

The limitations of this current study are as follow: the study population was all from Dubai city. It would have been beneficial if DS children from all around UAE participated, but this was unachievable due to time limitation, number of researchers examining the children, and facilities to accommodate a large number of participants. Since periodontal disease is a major concern in DS individuals, it would have been important to include other periodontal examination alongside the OHI.

CONCLUSIONS

This current study had concluded that DS children in Dubai had higher caries rate. Despite the high caries rate among DS patients, they received more restorations and dental treatment compared to the controls, which suggested that DS children had better access to dental care. In addition, DS children had significantly more calculus than healthy children. DS population had similar occlusal anomalies to DS individuals worldwide. They had significantly higher proportion of open bite, crossbite, scissor bite, anterior spacing, and posterior spacing. In addition, they had more Class III molar relationship compared to the control.

Looking at the outcome of this study, the following recommendations are suggested for the future research: to focus on parental awareness programs that stress the importance of oral health of special needs children, to establish proper prevention and community oral health-care programs that target special needs children in Dubai, and to conduct a similar study to include all DS

children in the UAE to have a better understanding of their oral health and treatment needs.

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CONFLICTS OF INTEREST

There are no conflicts of interest.

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