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Periodontal disease in Down's syndrome patients. A retrospective study

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Abstract

Aim: The purpose of this study was to assess the periodontal condition of people with Down syndrome (DS). Furthermore, risk factors were identified for the development of periodontitis.

Methods and results: Data were collected at the Centre for Special Care Dentistry (CBT) Rijnmond from the records of all 183 registered patients with DS who were 18 years of age on 31 December 2013. Patients were divided into two groups on the basis of their periodontal status: healthy or periodontally compromised. A total of 36.6% of the DS patients had actually incurred damage by periodontitis. The risk factors were: high age at the time of intake, large number of treatment sessions, and impossibility for the "Dutch Periodontal Screening Index" to be measured. In conclusion, the early introduction and continuous attendance of DS patients in a CBT can contribute to better results for a healthy periodontal condition.

KEY WORDS

Down syndrome, periodontal index, periodontitis

1 | INTRODUCTION

Periodontitis is a common dental disease for people with Down syndrome (DS). Periodontitis can be defined as the presence of gingival inflammation at sites where there has been a pathological detachment of collagen fibers and the junctional epithelium has migrated apically.¹ Primary clinical features include clinical attachment loss, alveolar bone loss, periodontal pocketing, and gingival inflammation. In addition, enlargement or recession of the gingiva, bleeding of the gingiva, increased mobility, drifting, and/or tooth exfoliation may occur.² Studies have shown that 33%–49% of DS patients experience advanced periodontal problems.^{3,4} More attachment loss was found in patients with DS compared to a control group of patients with a mental impairment other than DS.⁵ In plaque research on a relatively older DS population with severe periodontitis, no differences in the presence of subgingival plaque were detected.⁶

In addition to local risk factors (plaque and calculus), especially immunological problems play an important role.^{7–9} For people with DS in an institution where the infection pressure is higher, it was found that in the age group 16–45 years, 70% had become edentate by periodontal disease. Within the general population this was less than 1%.¹⁰ Other systemic risk factors include increasing age, male gender, smoking, having diabetes, stress, and certain genetic disorders.^{2,5,11–13}

The progression of periodontitis for people with DS is rapid, especially in the age group under 30 years.¹⁴ Reduced immunological defenses have been shown to play a greater role in the pathogenesis of periodontitis than poor oral hygiene.^{15–17} In addition, in this patient category, there are also other factors in the mouth that increase the risk of periodontitis, such as having short roots, low volume of the alveolar process, agenesis of neighboring elements, and a shorter frenulum of the lower lip.¹⁸

Poor oral hygiene does not automatically mean that periodontitis will develop, but when susceptibility to periodontitis has been shown, good oral hygiene helps to reduce and control periodontitis. People with intellectual disabilities show reduced cooperation with self-care, such as teeth brushing, but also with dental treatment.¹⁹ As the treatability is reduced, the relative strain caused by the same periodontal therapy increases. Also, early introduction of periodontal care, participation of parents/caregivers/institutional attendants, and frequency of attendance seem to improve periodontal outcomes in preventive of periodontal treatment of DS patients.²⁰

The purpose of this research is to identify the risk factors for the development of periodontitis, with the aim of describing a risk profile for people with DS. On the basis of such a profile, the dentist in a Centre for Special Care Dentistry (CBT) and/or general practice is in a better position to identify the DS patient with a high risk of developing periodontal dysfunction and to provide adequate treatment for that patient.

2 | MATERIAL AND METHODS

This cross-sectional record survey was carried out in collaboration with the CBT Rijnmond in Rotterdam, Netherlands.

2.1 | Data collection

For this study, data were collected from the records of all 183 patients with DS registered for treatment at the CBT Rijnmond, who were 18 years of age or older on 31 December 2013. Because of the nature of the study design, permission from a medical ethical committee was not necessary. All patients (ie, their parent or guardian) have given written informed consent in accordance with the guidelines and principles described by the World Medical Association (Declaration of Helsinki) regarding using information from dental records for research purposes. The patient records, from the moment of intake of the patient until December 2014, were reviewed by two dentists during the period of 01 January 2012 until 31 December 2014. The relevant data were subsequently anonymized and recorded into an EXCEL worksheet.

The data collected concerned some general characteristics of patients with DS, their oral health, their overall health, treatments performed, their oral health behavior, and their behavior during treatment. As to oral health, the most recent scores of patients, measured using the Dutch Periodontal Screening Index (DPSI) in 2012, 2013, or 2014, were included if they were present (Table 1).²¹ To the patients whose recent DPSI score was unknown, the evaluating dentists awarded a DPSI score using an estimate based on X-rays, old DPSI

scores, and the dentist/dental hygienist's report. Furthermore, the number of absent dental elements was recorded including cause of absence (caries, periodontitis, agenesis etc.), and whether deciduous teeth were in situ. Information about various systemic disorders (ie, diabetes, thyroid, and heart disorders) was also collected and it was determined whether or not a patient smoked. Information about the third molars was ignored.

In addition, it was recorded whether there had been a quarterly recall for periodontal treatment, including an assessment of possible bacterial growth of periopathogens. If *Aggregatibacter actinomycetemcomitans* were present, this was recorded.

The oral health behavior, such as allowing to be brushed at home and brushing method, was recorded as described in the patient file. It was also determined whether the patient had a habit of teeth grinding (bruxism). The degree of cooperation in measuring the DPSI, the "DPSI measurability," was scored using three levels. In addition, patients were classified according to Van Grunsven's behavioral scale: a scale for assessing the behavior of mentally handicapped children during dental treatment. This scale contains five scores: "0" nontreatable at all, "1" not cooperative, "2" wavering, "3" passive, and "4" cooperative.²²

In 2016, some additional data were collected from the dental records. For all patients, it was determined for how long the patient was or had been under treatment by recording the date of intake. Also, information was gathered on how many treatment sessions had taken place in the CBT's treatment clinic (oral hygienist and/or dentist) from the moment of intake until 30 April 2016. During the data collection process, the data were updated where possible, for example, by a visit to the dentist or the dental hygienist.

In order to obtain an estimate of the reliability of the recorded data, a third judge has also recorded the relevant data from the files in a random manner. There was no difference in recorded data between the dentists.

2.2 | Statistical analysis

All data were analyzed using IBM Statistical Package for Social Sciences (SPSS) for Windows Version 21 (IBM Corp., released 2012, Armonk, NY). To begin with by means of descriptive statistics, an overview was given of the characteristics of the patients with DS in terms of age and sex, general health, oral health, and oral health care they had received. After that, patients were divided into two groups on the basis of data on their periodontal health. Group 1: patients in whom periodontitis is absent or manageable. Criteria for this are: 0 dental elements are absent due to periodontitis and the total DPSI is "A" or "B" or the sub-DPSI contains up to one "C." Group 2: patients with periodontitis present and noncontrollable. Criteria for this are: 1 or more dental elements are

TABLE 1 DPSI score and explanation

0	No pockets >3 mm in depth, no calculus, no overhanging restorations and no bleeding on probing to the bottom of the pocket	DPSI A
1	No pockets >3 mm in depth, no calculus, no overhanging restorations, but presence of bleeding on probing to the bottom of the pocket	
2	No pockets >3 mm in depth, presence of bleeding on probing to the bottom of the pocket and presence of calculus or overhanging restorations	
3-	Presence of pathological pockets 4–5 mm without gingival recession	DPSI B
3+	Presence of pathological pockets 4–5 mm with gingival recession	DPSI C
4	Presence of pathological pockets ≥6 mm	

absent due to periodontitis and/or the sub-DPSI contains two or more times “C.”

In order to further assess the periodontal health of patients with DS, it was subsequently investigated to what extent there was a correlation between belonging to group 1 or group 2 and the various other characteristics of the patients. This was done, first, by using bivariate logistic regressions (Wald test, Odds ratio). Subsequently a multivariate logistic regression (Wald test, Odds ratio) was performed with all characteristics that were bivariate related ($P < 0.05$), with the aim to ascertain which patient characteristics are determinants of periodontal health in patients with DS. To this end, it was first checked whether the different (independent) patient characteristics were not (strongly) correlated (Chi Square test and Pearson's R). This, for example, was the case for some features that had a direct and substantive relation to periodontal health. These characteristics (“periodontal treatment recall” and “bacterial cultivation of periopathogens”) were then ignored. In the multivariate regression analysis, the “enter” procedure, the “forward,” “backward,” and “stepwise” procedures were applied. Use of these different procedures led to highly consistent results. In a second round, the multivariate analysis was repeated applying the “enter” procedure, using only the patient characteristics that showed statistical significance in the first round ($P < 0.05$).

3 | RESULTS

3.1 | General and oral health characteristics

Of the 183 patients with DS in this study, 58.9% were men; on January 1, 2014, they were on average 35.7 ($SD = 14.3$) years old. Of these, the youngest was 18 years old and the oldest patient was 69 years old. Furthermore, it was found that 28.4% were missing one or more elements (average 7.8) due to periodontitis and that for 72.7% one or more elements were absent for other reasons. Eventually 6.0% was edentate, 79.8% was dentate with, and 14.2% dentate without missing elements. Almost half of the patients (44.8%) were medically compromised. However, only a few smoked (Table 2).

3.2 | Self-care and care

For two-thirds of the dentate DS patients (66.9%), teeth were brushed or the patients brushed their teeth themselves. With these patients, an electric toothbrush was used in 62.4% of the cases. In the vast majority (84.9%) of dentate patients, the dentist was able to measure a DPSI (once or several times), and for 86.0%, the behavior was such that at least some form of dental treatment was possible (Table 3).

The average age of the DS patients at the time of intake was 23 years old, whereas at the time of this study, they had been on average over 14 years (172.3 months) in treatment. On average, patients consulted a dental and/or oral hygienist once every 4 months, whereas 18.0% of patients were seen quarterly for para-recall. In the case of 10.5% of the patients, a bacterial culture was taken at some point. With a third of those patients (30.0%), AA bacteria were found. Finally, 11.0% had been orthodontically treated at some point (Table 3).

3.3 | Periodontal health

Based on the number of lost elements due to periodontitis and the periodontal state of the existing teeth, a classification was made. This made clear that for 63.4% of patients, the periodontitis was manageable or absent, whereas for 36.6%, periodontitis had caused substantial damage to the dentition (Table 4).

Table 5 indicates that periodontal disorder in DS patients shows a bivariate correlation with age, age at intake, number of dental elements lacking due to unknown reasons, presence of deciduous teeth, and number of treatment sessions. Naturally, there was also a connection with the recall schedule for periodontal treatment, and with a bacterial culture having been taken.

Periodontal health also showed a bivariate correlation with the the “DPSI measurability” of patients, with their ability to undergo treatment, with brushing behavior, and with the possibility of orthodontic treatment.

Table 6 reveals that a multivariate model showed that only the age of intake, the number of treatment sessions, and the

TABLE 2 General characteristics and characteristics of oral health and general health of patients

	Prop.	Mean	SD	Minimum	Maximum
General characteristics					
Male ^a	58.9%				
Age in January 2014		35.7	14.3	18	68
- 18–20 years	15.3%				
- 21–30 years	31.1%				
- 31–40 years	16.4%				
- 41–50 years	17.0%				
- 51–60 years	15.8%				
- 61+ years	4.4%				
Characteristics of oral health of patients					
Missing teeth because of:					
(a) Periodontitis ^b	28.4%	7.8	7.6	1	28
(b) Agenesis ^b	32.8%	2.4	1.6	1	7
(c) Agenesis (deciduous tooth present) ^b	21.9%	2.3	1.6	1	7
(d) Caries ^b	28.4%	5.1	6.9	1	28
(e) Impaction ^b	9.8%	1.8	1.0	1	4
(f) Impaction (deciduous tooth present) ^b	1.1%	1.5	0.7	1	2
(g) Orthodontic treatment ^b	7.1%	2.2	1.1	1	4
(h) Known other reason ^b	12.6%	2.4	5.2	1	26
(i) One or more teeth missing (subtotal) (b+c+d+e+f+g+h) ^b	72.7%	4.6	5.1	1	28
(j) Unknown reason ^b	35.0%	6.1	4.6	1	19
Dentate, no teeth missing	14.2%				
One or more teeth missing ^b	79.8%	9.0	8.2	1	28
Edentulous	6.0%				
One or more deciduous teeth ^b	23.0%	2.1	1.8	1	8
Characteristics of general health of patients					
Diabetes type 1 ^a	0.5%				
Diabetes type 2 ^a	1.1%				
Thyroid disorder: hypothyroidism ^a	20.2%				
Thyroid disorder: hyperthyroidism ^a	3.8%				
congenital heart defect ^a	20.8%				
Noncongenital heart defect ^a	4.9%				
(Non-)congenital heart defect ^a	2.2%				
Medically compromised ^a	44.8%				
Smoking ^a	0.5%				
<i>n</i> = 183					

Abbreviation: Prop., proportion patients with condition.

^aDummy variable (0/1) representing Prop.

^bDummy variable (0/1) representing Prop. + descriptive statistics for patients with condition.

possibility to determine a DPSI may affect the periodontal health of DS patients.

4 | DISCUSSION

In addition to general dental practices, there is a network of centers for special care dentistry in the Netherlands

(independently or affiliated with a hospital or institution). Normally, patients go to a general dental practitioner, but if treatment becomes too complicated (ie, behavior, complex dentition, medically compromised) a general dental practitioner can refer patients to a CBT. The results of this study show that 36.6% of patients with DS, all treated at a center for special care, had to a greater or lesser extent incurred dental damage by the presence of periodontitis. This outcome

TABLE 3 Behavioral characteristics of patients and characteristics of treatment

	Prop.	Mean	SD	Minimum	Maximum
Behavioral characteristics of patients					
Bruxism ^a	29.2%				
DPSI measurability					
- Yes, in one or more times	84.9%				
- No	12.8%				
- Not applicable	2.3%				
Cooperation during oral care					
- Able to do itself	12.8%				
- Should be helped and allows help	54.1%				
- Should be helped, but does not get it	29.7%				
- Cannot be brushed	0.5%				
- Unknown	2.9%				
Brushing method ^b					
- Manual	30.1%				
- Electric or electric and manual	62.4%				
- Unknown	7.5%				
Behavioral score ^c					
- Untreatable/not cooperative	14.0%				
- Wavering/pассив/ cooperative	86.0%				
Stress ^d					
- No, not at all	43.6%				
- Yes, (somewhat)	44.8%				
- Unknown	11.6%				
<i>n</i> = 172					
Characteristics of Treatment					
Age at intake		23.0	15.2	3	58
Number of months in treatment		172.3	94.1	9	408
Number of treatment sessions		45.3	27.9	6	138
Mean treatment interval (in months)		4.0	1.5	1.3	14.5
Periodontal treatment recall ^e	18.0%	3.5	1.0	3	6
Orthodontic treatment ^f	11.0%				
Bacterial cultivation of periopathogens ^f	10.5%				
Presence of AA-bacteria ^g	30.0%				
<i>n</i> = 183					

Abbreviation: Prop., proportion patients with condition.

^aDummy variable (0/1) representing Prop.

^b*n* = 93 (only those who brush self or can be brushed).

^cBehavioral score "van Grunsven."

^dExperienced level of stress during oral care.

^eDummy variable (0/1) representing Prop. for dentate patients with condition + descriptive statistics for dentate patients with condition.

^fDummy variable (0/1) representing Prop. for dentate patients with condition.

^g*n* = 20

is consistent with results of earlier studies, with advanced periodontal degradation occurring in a range of 33%–49% of DS patients.^{3,4,9}

The risk factors for developing periodontitis are, as evidenced by this study, a high age at intake, a large number of treatment sessions, and not allowing the DPSI to be measured.

The higher the age at intake, the greater the chance of developing periodontitis. This can be explained because age itself is already a predictor for developing periodontitis.^{2,23} The reason of the high age at intake can be explained by the fact that DS patients can be under treatment by a general dental practitioner. But when getting older, the treatability of

TABLE 4 Periodontal health of patients

Missing teeth because of periodontitis	periodontal state present teeth			Total	%
	Good ^a	Bad ^b	Total		
0	116	63.4%	15	8.2%	131
1–4	11	6.0%	14	7.7%	25
5–28	5	2.7%	22	12.0%	27
Total	132	72.1%	51	27.9%	183
					100.0%

Group 1: patients with whom periodontitis is absent or manageable (0 dental elements are absent due to periodontitis and the total DPSI indicates good periodontal health). Group 2: patients with periodontitis present and/or non-controllable (1 or more dental elements are absent due to periodontitis and/or the total DPSI indicates good periodontal health).

^aThe total DPSI is “A” or “B” or the sub-DPSI contains up to one “C.”

^bThe sub-DPSI contains two or more times “C.”

TABLE 5 Bivariate relations between periodontal problems (1) or no periodontal problems (0) and characteristics of DS patient and treatment characteristics (logistic regression)

	B	Wald	exp(B)	95% CI		Significance
				Lower	Upper	
Woman ^a	0.13	0.17	1.14	0.62	2.10	0.68
Age in January 2014	0.09	40.05	1.09	1.06	1.12	*0.00
Number of teeth missing ^b	0.01	0.09	1.01	0.93	1.10	0.77
Number of teeth missing (reason unknown)	0.20	17.47	1.22	1.12	1.34	0.00
One or more deciduous teeth	-1.35	9.03	0.26	0.11	0.63	*0.03
Medically compromised ^a	0.27	0.78	1.31	0.72	2.41	0.38
Bruxism ^a	0.03	0.03	1.03	0.71	1.51	0.86
Electric teeth brushing ^a	-0.29	0.74	0.75	0.39	1.45	0.39
DPSI is measurable ^a	-1.62	11.12	0.20	0.08	0.51	*0.00
Cooperation during oral care ^a	-1.28	13.06	0.28	0.14	0.56	*0.00
Behavioral score “Van Grunsven” ^a	-1.09	6.06	0.34	0.14	0.80	*0.01
Stress ^a	0.34	0.99	1.40	0.72	2.71	0.32
Age at intake	0.72	33.98	1.07	1.05	1.10	*0.00
Number of months in treatment	0.00	0.10	1.00	0.99	1.00	0.76
Number of treatment sessions	0.02	6.70	1.02	1.00	1.03	*0.01
Periodontal treatment recall ^a	1.21	9.19	3.34	1.53	7.30	*0.00
Orthodontic treatment ^a	-1.75	5.24	0.17	0.04	0.78	*0.02
Assessment of periopathogens ^a	2.52	15.11	12.47	3.49	44.86	*0.00

n = 155–180

Abbreviation: CI, confidence interval; Prop., proportion patients with condition.

^aDummy variable (0/1) representing Prop.

^bFor other reason than periodontal problem.

*P ≤ 0.05

some DS patients diminishes and they are being referred to a special care dentist. Periodontal damage has already occurred and often it takes time before DS patient is familiarized to start a periodontal treatment at a center of special care dentistry. For that reason, it may be wise to refer DS patients at a young age. The positive relationship between the number of treatment sessions and the presence of periodontal problems may be due to the application of the so-called “Paroprotocol” that is followed at the CBT. According to this protocol, a patient with periodontitis should be seen every 3 months for treatment and/or assessment. Taken into account among

others, the periodontal condition, the degree of cooperation, and the level of oral hygiene, this recall period can be longer or shorter. So, for this specific group of patients, there is a high chance that they have periodontitis when they have been in many treatment sessions. However, this interpretation should be considered with care, because in this study, all treatment sessions at the CBT were counted, regardless of the nature of these sessions. After all, not all treatment sessions involved periodontal treatments. However, the frequency of attendance seems to improve periodontal outcomes of treatment of DS patients.²⁰

TABLE 6 Multivariate relations between periodontal problems (1) or no periodontal problems (0) and characteristics of DS patient and treatment characteristics (logistic regression)

	B	Wald	exp(B)	95% CI		Significance
				Lower	Upper	
Constant	-2.63	11.69	0.07			*0.00
Age at intake	0.08	29.84	1.08	1.05	1.11	*0.00
Number of treatment sessions	0.03	15.24	1.03	1.01	1.04	*0.00
DPSI is measurable ^a	-1.41	6.75	0.24	0.08	0.69	*0.01

n = 168

Abbreviation: CI, confidence interval; Prop., proportion patients with condition.

Nagelkerke R^2 = 0.39

^aDummy variable (0/1) representing Prop.

* $P \leq 0.05$

To determine the DPSI, the patient must be cooperative. It was found that good cooperation is associated with a lower probability of periodontal problems. This might be explained by the fact that these patients are better treatable and/or have a better oral hygiene, which improves the periodontal condition. According to existing literature, people with intellectual disabilities show reduced cooperation regarding self-care, but also regarding dental treatment.¹⁹

Furthermore, the bivariate analysis showed that the presence of deciduous teeth, the degree of cooperation in the treatment setting (such as the ability to undergo dental [orthodontic] treatment, as measured according to the behavioral scale of "Grunsvén") as well as the cooperation in daily oral care were related with getting or not getting periodontal problems. These are all variables that say something about the treatability of the patients. In the multivariate analysis, these variables are, as it were, eliminated and DPSI measurability appeared to be the strongest factor to indicate patient's treatability.

In this study, we only looked at brushing teeth with dentifrice as a preventive measure. But even more preventive measures are known, such as brushing with chlorhexidine.²⁴ This could be advised as a preventive measure to improve the periodontal condition as well, especially for less treatable patients.

Although the interaction of the immune response with the bacteria is considered more important than the presence of specific bacteria, the presence of *A. actinomycetemcomitans* is specific for periodontitis.⁶ However, in this study, there is too little power and too little additional information to make statements considering the presence of this bacterium.

The number of patients that had been seen for periodontal recall was low (18.0%). This is remarkable because 36.6% of the patients had a damaged dentition due to periodontal dysfunction. This study has only considered patients who actually visited the CBT every 3 months. In fact, the indication by the dentist or dental hygienist for a quarterly recall was given more frequently, but the 3-month period is often not realized

for reasons, such as overburdening of the family, lack of available supervisors, vacations, traffic, etc.

The literature shows that, of the various medical conditions, diabetes increases the risk of periodontal problems.¹³ However, in this study, relationships between different medical conditions and periodontal problems could not be shown, possibly because of the relatively low number of observations. The same applies for the risk factor of smoking.¹¹

Through this study, the periodontal oral health of a group of people with DS was assessed by retrospective analysis of patient record information. It should be noted that it was sometimes difficult to obtain the required data from the files. The files were digitally available from 2009, but information about the time before had to be obtained from handwritten patient files. The information was not always clearly described or the hand writing was not readable. As a result, some data needed for the investigation were not accessible.

In addition, in the case of the elderly patients, the reason for the absence of certain elements was relatively often unknown. The positive relationship with periodontal problems indicates that, in those cases too, the loss may have been caused by previous periodontal problems. As a result, this study may be taken to indicate that the actual percentage of patients with severe periodontal problems is in fact even higher than the percentage we observed.

5 | CONCLUSION

From this study, it becomes clear that patients with DS, visiting a special care dentist regularly, showing good cooperation during dental treatment and performing adequate dental self-care (with help), have less chance of developing periodontitis. It also turns out to be important for periodontal health of these patients to start as early in life as possible with regular dental screening and treatment. Participating in a familiarization program may well contribute to improved treatability and, by doing so, the prevention of periodontal problems.

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