© Borgis Nowa Stomatol 2019; 24(1):20-26 DOI: https://doi.org/10.25121/NS.2019.24.1.20

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Oral hygiene and periodontal status in children and adolescents with Down syndrome

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Keywords

cross-infection, restorative dentistry, restorative materials

Summary

Introduction. Dental procedures bear risk of pathogens transmission leading to cross-infection. Means of protection aim at preventing direct contact with patient's infected tissues. Less attention is paid to indirect threats, such as the restorative material's infection during treatment. Restorative materials portioned and packed in disposable blisters may effectively eliminate the risk of material's contamination.
Aim. The aim of the study was to assess the knowledge and attitude of polish dental students on infection of dental restorative materials during treatment.
Material and methods. A survey was conducted among students of the Faculty of Dentistry at the Medical University of Warsaw, who were given disposable packages of the restorative material for cavity reconstruction during practical classes.

Introduction

Down syndrome (DNS) is the most common autosomal chromosome abnormality in humans, covering a spectrum of characteristic traits. In 1959, DNS was found by Lejeune to be caused by the presence of an extra copy of chromosome 21 (1).

Chromosome 21 is the smallest human chromosome. It is classified as belonging to the G group of chromosomes responsible for the somatic development of reproductive organs, pelvis, heart, epicanthic folds, iris, lens, paranasal sinuses, phalanges and metacarpus, palmar and plantar dermatoglyphics, as well as muscle tone, cartilage and tendon elasticity, proportion between limbs and the trunk, and cranial proportions. The chromosome also determines the auricular shape, quality and quantity of hair, size of teeth, thickness of neurocranial bones, and intelligence and intellectual development (2, 3). The presence of an additional copy of chromosome 21 (or its long arms) causes metabolic disorders, internal organ defects, tissue dimorphism, and characteristic phenotypic features with varying degrees of mental retardation (3-7).

Oral cavity abnormalities such as malocclusion and disproportion in growth between the masticatory system and the tongue – as well as abnormal breathing patterns, poorer hygiene due to impaired manual skills and lower self-cleaning ability (reduced secretion of saliva) – imply the development of caries and periodontal diseases in patients with Down syndrome (8).

In addition to topical factors, an important role in the development of periodontal diseases is attributed to generalized factors including impaired circulation leading to tissue hypoxia, reduced immunity, and propensity to infections, as well as systemic endocrine dysfunction. The first symptoms of periodontal diseases occur as early as between 6 and 15 years of age. The disorders may take the form of marginal gingivitis, acute or subacute necrotizing gingivitis, advanced periodontitis, gingival recessions as well as vertical and horizontal bone atrophy. A factor predisposing to the development of periodontitis is the presence of specific bacterial flora including *Aggregatibacter actinomycetemcomitan*s and *Porphyromonas gingivalis*, *Tannerella forsythia*, *Treponema denticola*, forming the so-called "red complex" (9-14).

Aim

The aim of the study was to determine the oral hygiene and periodontal status in children and adolescents with Down syndrome compared to healthy individuals.

Material and methods

A total of 150 subjects of both sexes (66 boys and 84 girls) aged between 5 and 21 years were selected for the study. The study group comprised children and adolescents with Down syndrome (n = 75), pupils of the Special School and Educational Centre No. 8 and 9, and the Special School and Educational Centre No. 10 in Wroclaw. The control group consisted of generally healthy children and adolescents (n = 75), age- and gender-matched to the study group, receiving dental treatment at Stomatologiczne Centrum Transferu Technologii Sp. z o.o., NZOZ Akademicka Poliklinika Stomatologiczna (University Dental Polyclinic) in Wroclaw.

The clinical oral examination evaluating the level of oral hygiene and periodontal status was carried out at the University Dental Polyclinic under artificial light, using a standard mouth mirror and a WHO-621 probe. The results of the examination were recorded in a specially prepared study sheet. The parents/carers were requested to fill in a questionnaire containing questions about the hygiene habits of the study patients. Questions asked in the survey included whether the child brushes his/her teeth, whether he/she performs this activity on his/her own or with the help of parents, when the child last brushed his/her teeth, whether the child cleans his/her teeth with a manual or electric toothbrush, and whether he/she uses dental floss, interdental brushes, toothpicks, and chewing gum.

Oral hygiene was evaluated using the Oral Hygiene Index-Simplified (OHI-S) of Greene and Vermillion, and the Approximal Plaque Index (API). The periodontal status was assessed using the Gingival Index (GI) of Löe and Sillness, and the modified Sulcus Bleeding Index (mSBI).

The results were analyzed statisically using the chi-square test, Pearson correlation coefficient and analysis of variance. The level of significance was $p \leq 0.05$.

The study was approved by the Bioethics Committee at Wroclaw Medical University (approval no. KB – 71/2014).

Results

The prevalence of periodontitis in patients with Down syndrome was 100% and was thus 14.7% higher than in the healthy controls (100.0 vs. 85.3%; $p < 0.001$) (fig. 1).

The DNS patients had a poorer periodontal status compared to the healthy controls, as evidenced by significantly higher GI and mSBI values ($p < 0.001$). However, even though the GI level was approximately 3 times higher in the DNS patients than in healthy controls (0.90 ± 0.56 vs. 0.39 ± 0.53), the values obtained in both groups were in the range of 0.1-1.0, indicating mild gingivitis.

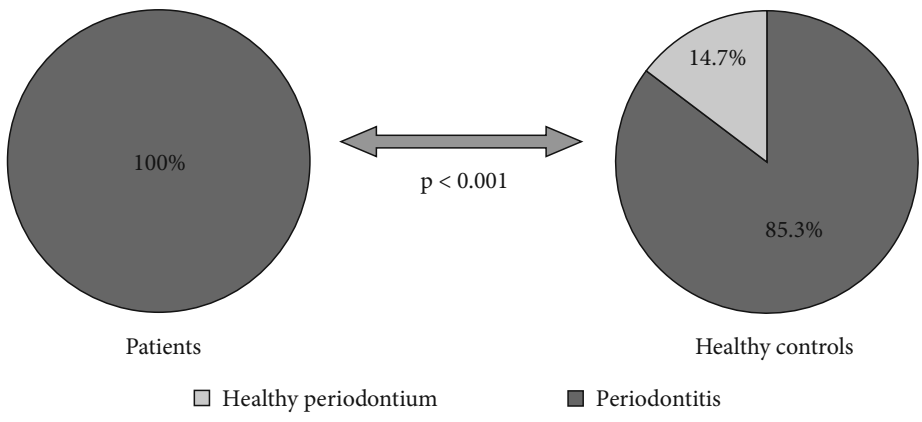
The mSBI value, which was equal to 70.99% ± 27.65 in the DNS patients, indicates severe generalized gingivitis, while the value of the index in the healthy subjects (26.69% ± 34.94) suggests mild gingivitis (tab. 1).

Oral hygiene was worse in the DNS patients than in the healthy individuals, too. The mean OHI-S score was 1.68 ± 0.68 including the Debris Index (DI-S) of 1.58 ± 0.65 and the Calculus Index (CI-S) of 0.10 ± 0.14. The values of the Debris Index (DI-S) were found to be significantly higher ($p < 0.01$) in the DNS patients compared to the healthy controls, contributing to significantly higher values of the Oral Hygiene Index (OHI-S). There were no significant differences between the values of the Calculus Index (CI-S).

A significantly higher API level was noted in the DNS patients (86.66% ± 17.78; $p < 0.001$) than in the healthy controls (66.34% ± 34.33), nevertheless the values in both

Tab. 1. Periodontal status

	Study group	Control group	Significance of differences
Indices	x ± SD	x ± SD	
mSBI (%)	70.9 ± 27.65	26.69 ± 34.94	$p < 0.001$
GI	0.90 ± 0.56	0.39 ± 0.53	$p < 0.001$



Ryc. 1. Frekwencja zapaleń przyzębia

groups were in the range suggesting a need to improve the state of oral hygiene (tab. 2) (fig. 2a-5).

Patients with Down syndrome exhibited a positive correlation between the values of OHI-s and API, and the values of mSBI and GI. In the healthy controls, a positive correlation was found only for OHI-s and API with mSBI (tab. 3).

Significantly more ($p < 0.001$) DNS patients than healthy individuals used a manual toothbrush (98.7 vs. 64%), and fewer participants used manual and electric toothbrushes interchangeably (49.3 vs. 6.7%; $p < 0.001$). The DNS patients more often than the healthy controls brushed their teeth with the help of a caregiver (44.4 vs. 0.0%; $p < 0.001$). Significantly more ($p < 0.001$) healthy participants than DNS patients declared using interdental brushes, dental floss and chewing gum (9.3 vs. 0.0%; 29.3 vs. 0.0%; 100 vs. 60%). There were no significant differences between the

Tab. 2. Oral hygiene status

	Study group	Control group	Significance of differences
Indices	x ± SD	x ± SD	
OHI-S	1.68 ± 0.68	1.32 ± 0.76	$p < 0.01$
DI-S	1.58 ± 0.65	1.17 ± 0.65	$p < 0.001$
CI-S	0.10 ± 0.14	0.16 ± 0.28	NS
API (%)	86.66 ± 17.78	66.34 ± 34.33	$p < 0.001$

NS – statistically insignificant difference

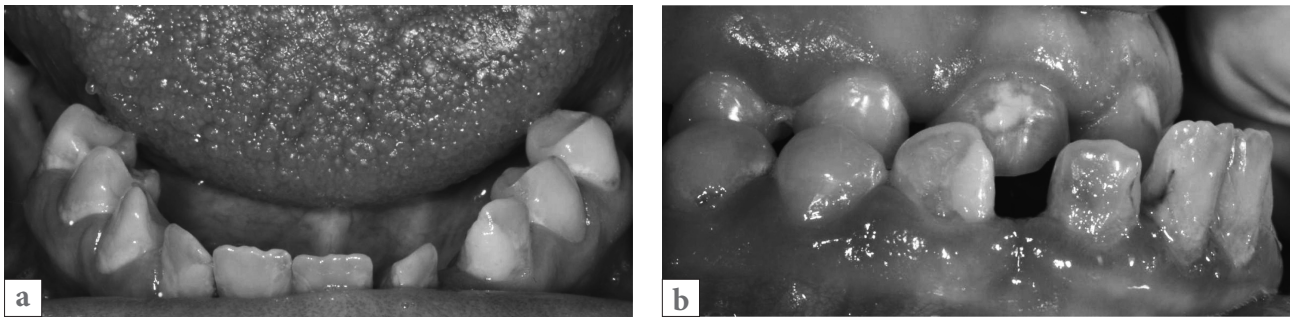


Fig. 2a, **b.** Poor oral hygiene and gingivitis in a patient with Down syndrome (female patient IN, 19 years old)

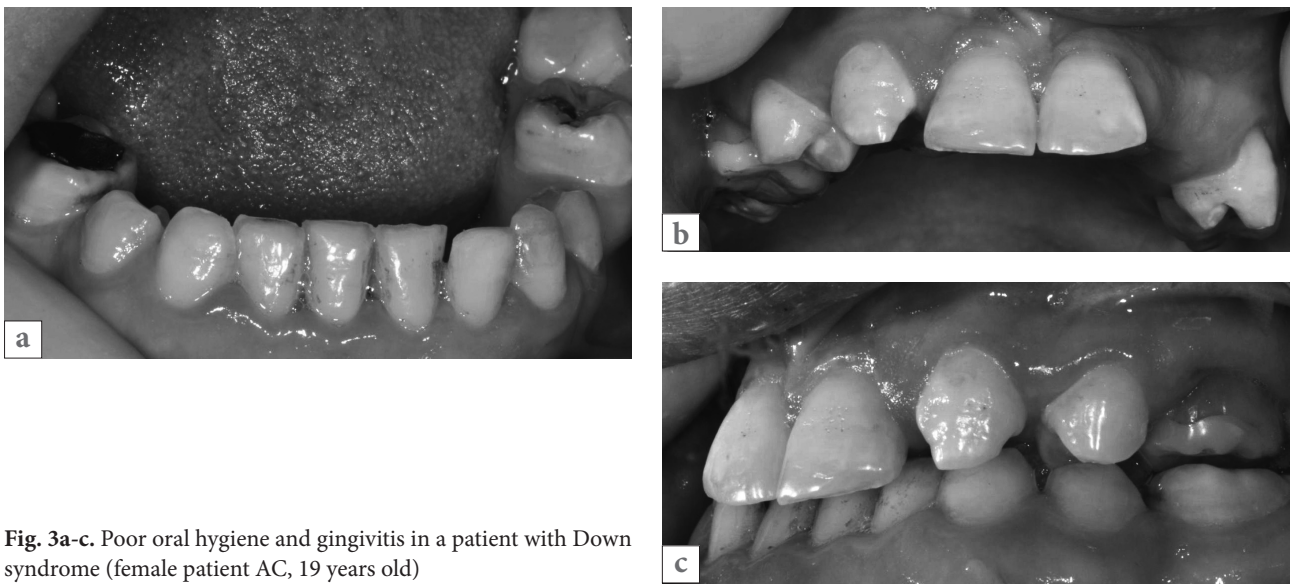


Fig. 3a-c. Poor oral hygiene and gingivitis in a patient with Down syndrome (female patient AC, 19 years old)

Fig. 4. Poor oral hygiene and gingivitis in a patient with Down syndrome (female patient DW, 17 years old)

Fig. 5. Poor oral hygiene and gingivitis in a patient with Down syndrome (male patient PG, 19 years old)

DNS patients and the healthy individuals in the declared use of toothpicks.

Discussion

Periodontal diseases are relatively common in patients with Down syndrome. Periodontal problems may first appear as early as after the eruption of the first deciduous teeth. The prevalence of periodontal diseases in patients under 30 years of age varies from 36 to 100%, and gingivitis from 14 to 100%. The progression of the disease is rapid particularly in younger people (15-19).

The development of periodontal diseases in patients has been postulated to be linked to the specific bacterial flora in the subgingival plaque (9-11, 13-15, 20-22). Bacteria colonizing tooth surfaces are essential in the induction of an inflammatory response in the periodontal tissues, however it is only in combination with impaired immune response (dysfunction of polymorphonuclear leukocytes and monocytes, reduced T cell function after the age of 10 years, decreased T cell count and their immaturity, altered expression of resistance associated genes) that they cause destructive periodontal disease (22-28).

Tab. 3. Correlation coefficients of oral health determinants

Control group						
	OHI-S	**CI-S**	**DI-S**	**API**	**SBI**	**GI**
OHI-S		.56*	0.93*	.65*	0.49*	0.08
CI-S	0.37*		0.22	.32*	.37*	-0.12
DI-S	0.98*	0.17		0.62*	0.42*	0.15
API	0.62*	0	.66*		0.56*	0.03
SBI	0.79*	0.19	0.8*	0.7*		0.22
GI	0.82*	0.16	.83*	.65*	0.77*	
Study group						

*Significance of differences: $p < 0.05$

Topical factors such as malocclusion, traumatic bite, crowding of teeth, bruxism, tongue pressure on teeth, mouth breathing – in addition to an increased accumulation of dental deposits – also predispose to the development of periodontal disease in patients (9, 11, 16, 28-32).

Studies by Zigmond et al. (33) show that a significant role in the development of periodontal diseases in DNS patients should be attributed to the immune factor, as periodontal diseases were found to be significantly more prevalent and considerably more severe in the Down syndrome patients despite the fact that the Plaque Index values in the patients and healthy controls were similar. Reuland-Bosma et al. (1987) conducted a clinical experiment involving the induction of gingivitis by temporary discontinuation of plaque removal in a Down syndrome child and her healthy sibling. There were no differences in the Plaque Index between the study participants, but the values of the Gingival Index (GI) were approximately twice as high in the DS child, which was attributed to differences in immune response corroborated by the results of analysis of gingival biopsy material.

Patients with Down syndrome have difficulty with maintaining a satisfactory level of oral hygiene. Many authors point to unsatisfactory oral hygiene as a major topical factor affecting the development of periodontal diseases, revealing a positive correlation (15, 29, 30, 32, 34, 35).

Our data also reveal a positive correlation between oral hygiene indices and periodontal indices in both groups. As the values of hygiene indices grew, the value of the modified Sulcus Bleeding Index (mSBI) also increased, which indicates unambiguously that poorer oral hygiene is associated with more severe periodontal inflammation.

Furthermore, most studies indicate that the level of hygiene in patients is worse than in healthy controls (16, 18, 29-31, 36-40).

Our results are consistent with the findings of the above-mentioned authors published to date. The values of

the Oral Hygiene Index (OHI-S) and the Debris Index (DI-S) were significantly higher in the patients compared with the healthy subjects (1.68 ± 0.68 vs. 1.32 ± 0.7, $p < 0.01$; 1.58 ± 0.65 vs. 1.17 ± 0.65, $p < 0.001$). However, no significant differences were found between the values of the Calculus Index (CI-S). Similarly, Lopez-Perez et al. (16) reported a significantly lower percentage of patients with calculus, and a significantly higher percentage of patients with dental plaque compared to healthy controls. Cutress (29) and Orner (30) also observed higher values of the Calculus Index in patients than in healthy individuals, and a significant positive correlation between the Calculus Index and periodontal status.

In our studies, the cleaning of interdental spaces was also found to be ineffective, as evidenced by the high value of the Approximal Plaque Index (API) in both groups under study, but significantly higher in the patients compared to the healthy controls (86.66% ± 17.78 vs. 66.34% ± 34.33; $p < 0.001$). The hygiene indices observed in both study groups show that the oral hygiene needs improvement.

The clinical study corroborates the results of the survey, as no patients reported using dental floss or interdental brushes. More than half of the patients (56.0%) reported that they brushed their teeth on their own, while the remaining patients performed oral hygiene procedures with the help of a carer. Similar percentages of patients cleaning their teeth unassisted (51.0%) were reported by Bradley and McAlister (41), while De Jongh et al. (42) observed that 93.3% of patients performed their daily oral hygiene routine with the help of carers.

The level of oral hygiene may be better in younger patients, as they receive help with tooth cleaning from their parents/carers. However, as the patients grow older, the involvement of parents/carers becomes more limited, as they believe that older children do not need their assistance in tooth brushing any more. Consequently, the state of hygiene deteriorates with age.

Oredugba (37) and Kumar et al. (38) and Al Sufyani et al. (18) demonstrated better oral hygiene in younger than in older patients, with age-related deterioration, which was attributed to the fact that younger children were more frequently assisted by their parents in performing basic hygiene activities. Al Habashneh et al. (40) noted that 22.3% of patients aged 12-16 years failed to perform any hygienic procedures in the oral cavity. Similar findings were observed by Al Sufyani et al. in 2014. The authors reported that 19.8% of patients aged 6-16 years never cleaned their teeth. Allison and Lawrence (36) highlighted that the level of hygiene in Down syndrome patients staying in care facilities was inferior compared to patients living at home with their parents. Pels (43) identified a correlation between the degree of mental disability of patients and their oral hygiene condition, which was found to deteriorate with increasing degree of mental disability. Also, Kumar et al. (38), in addition to the effect of unsatisfactory oral hygiene on periodontitis, demonstrated a correlation between oral hygiene and periodontitis and the degree of intellectual disability, but also the level of parents' education and their economic status. Al-Sufyani et al. (18) demonstrated a positive correlation between the education of patients' parents and the level of oral hygiene.

Teitelbaum et al. (39) showed that dental cleaning with a toothbrush and toothpaste alone was insufficient in patients with Down syndrome on account of their specific morphological traits including macroglossia, malocclusion and dental defects which hinder tooth cleaning. Therefore, the efficiency of cleaning needs to be enhanced through the use of antibacterial agents (chlorhexidine products). An additional use of a plaque disclosing agent in patients with moderate intellectual disability associated with Down syndrome, is a strong motivator for better plaque removal by more effective tooth brushing.

Conclusions

Our study showed a significant correlation between oral hygiene (presence of dental plaque) and periodontal inflammation. Higher GI and mSBI values in the DNS patients than in the healthy controls indicate a poorer periodontal status in the former group.

Conflict of interest

None

References

1. Prasher VP: Comparison of physical and psychiatric status in individuals with translocation and trisomy 21 Down syndrome. Downs Syndr Res Pract 1995; 3(1): 9-13.
2. Sustrova M, Sarikova V: Down's syndrome-the impact of increased expression of genes of the 21st chromosome on the functions of immunity and nervous systems. Bratisl Lek Listy 1997; 98(4): 221-228.
3. Sadowska L, Mysłek-Prucnal M, Choińska AM, Mazur A: Diagnostyka i terapia dzieci z zespołem Downa w świetle badań własnych i przeglądu literatury przedmiotu. Przegl Med Uniw Rzesz 2009; 1: 8-30.
4. Opitz JM, Gilbert-Barness EF: Reflections of the pathogenesis of Down Syndrome. Am Med Genet Supp 1990; 7: 38-51.

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5. Coe DA, Matson JL, Russell DW et al.: Behavior problems of children with Down syndrome and life events. J Autism Dev Disord 1999; 29(2): 149-156.
6. Hattori M, Fujiyama A, Taylor TD et al.: The DNA sequence of human chromosome 21. Nature 2000; 405: 311-319.
7. Moraes MEL, Bastos MS, Santos LR et al.: Dental age in patients with Down syndrome. Braz Oral Res 2007; 21(3): 259-264.
8. Azfar M, Khan I, Iqbal N et al.: Oral health of individuals with Down syndrome in Karachi, Pakistan. J Pak Dent Assoc 2018; 27(4): 190-194.
9. Hanookai D: Herpesviruses and periodothopathic bacteria in Trisomy 21. J Periodontol 2000; 71: 376-384.
10. Sakellari D, Belibasakis G, Chadjipadelis T et al.: Supragingival and subgingival microbiota of adult patients with Down's syndrome. Changes after periodontal treatment. Oral Microbiol Immunol 2001; 16(6): 376-382.
11. Sakellari D, Arapostathis KN, Konstantinidis A: Periodontal conditions and subgingival microflora in Down syndrome patients. J Clin Periodontol 2005; 6: 684-690.
12. Yoshihara T, Morinushi T, Kinyo S, Yamasaki Y: Effect of periodic preventive care on the progression of periodontal disease in young adults with Down's syndrome. J Clin Periodontol 2005; 32(6): 556-560.
13. Martinez-Martinez RE, Loyola-Rodriguez JP, Bonilla-Garro SE et al.: Characterization of periodontal biofilm in Down syndrome patients: a comparative study. J Clin Pediatr Dent 2013; 37(3): 289-295.
14. Ahmed N, Parthasarathy H, Arshad M et al.: Assessment of Porphyromonas gingivalis and Aggregatibacter actinomycetemcomitans in Down's syndrome subjects and systemically healthy subjects: A comparative clinical trial. J Indian Soc Periodontol 2014; 18(6): 728-733.
15. Reuland-Bosma W, van Dijk J: Periodontal disease in Down syndrome: a review. J Clin Periodontol 1986; 13(1): 64-73.
16. Lopez-Perez R, Borges-Yáñez SA, Jiménez-García G, Maupomé G: Oral hygiene, gingivitis and periodontitis in persons with Down syndrome. Spec Care Dentist 2002; 22(6): 214-220.
17. Morgan J: Why is periodontal disease more prevalent and more severe in people with Down syndrome? Spec Care Dentist 2007;27(5): 196-201.
18. Al-Sufyani GA, Al-Maweri SA, Al-Ghashm AA, Al-Soneidar WA: Oral hygiene and gingival health status of children with Down syndrome in Yemen: A cross-sectional study. J Int Soc Prev Community Dent 2014; 4(2): 82-86.
19. Rahul VK, Mathew C, Jose S et al.: Oral manifestation in mentally challenged children. J Int Oral Health 2015; 7(2): 37-41.
20. Khocht A, Yaskell T, Janal M et al.: Subgingival microbiota in adult Down syndrome periodontitis. J Periodont Res 2012; 47: 500-507.
21. Page RC, Offenbacher S, Schroeder HE et al.: Advances in the pathogenesis of periodontitis: summary of developments, clinical implications and future directions. Periodontol 2000 1997;14: 216-248.
22. Carrada CF, Scalioni F, Cesar D et al.: Salivary periodontopathic bacteria in children and adolescents with Down syndrome. PLoS One 2016; 11(10): e0162988.
23. Barkin RM, Weston WL, Humbert JR, Maire F: Phagocytic function in Down syndrome. I. Chemotaxis. J Ment Defic Res 1980; 24: 243-249.
24. Gemmell E, Marshall RI, Seymour GJ: Cytokines and prostaglandins in immune homeostasis and tissue destruction in periodontal disease. Periodontol 2000 1997; 14: 112-143.
25. Emingil G, Atilla G, Baskesen A, Berdeli A: Gingival crevicular fluid EMAPII, MIP-1alpha and MIP1beta levels of patients with periodontal disease. J Clin Periodontol 2005; 32(8): 880885.
26. Ram G, Chinen J: Infections and immunodeficiency in Down syndrome. Clin Exp Immunol 2011; 164: 9-16.
27. Cavalcante LB, Tanaka MH, Pires JR et al.: Expression of the interleukin-10 signaling pathway genes in individuals with Down syndrome and periodontitis. J Periodontol 2012; 83: 926-935.
28. Ferreira R, Michel RC, Greghi SL et al.: Prevention and Periodontal Treatment in Down Syndrome Patients: A Systematic Review. PLoS One 2016; 11(6): e0158339.

29. Cutress TW: Periodontal disease and oral hygiene in trisomy 21. Arch Oral Biol 1971; 16(11): 1345-1355.
30. Orner G: Periodontal disease among children with Down's syndrome and their siblings. J Dent Res 1976; 55: 778-782.
31. Buckley S, Sacks B: Oral health problems and quality of life. Downs Syndr Res Prac 2007; 12(1): 17.
32. Grollmus ZCN, Morales Chavez MC, Donat FJS: Periodontal disease associated to systemic genetic disorders, Med Oral Patol Oral Cir Bucal 2007; 12: E211-215.
33. Zigmond M, Stabholz A, Shapira J et al.: The outcome of a preventive dental care programme on the prevelence of localized aggressive periodontitis in Down's syndrome individuals. J Intell Dis Res 2006; 50(7): 492-500.
34. Shapiro S, Gedalia L, Hofman A, Miller M: Periodontal disease and blood citrate levels in patients with trisomy 21. J Dent Res 1969; 48: 1231-1233.
35. Loureiro ACA, Oliveira Costa F, da Costa JE: The impact of periodontal disease on the quality of life of individuals with Down syndrome. Downs Syndr Res Pract 2007; 12(1): 50-54.
36. Allison PJ, Lawrence HP: A paired comparison of dental care in Canadians with Down syndrome and their siblings without Down syndrome. Community Dent Oral Epidemiol 2004; 32(2): 99-106.
37. Oredugda FA: Oral health condition and treatment needs of a group of Nigerian individuals with Down syndrome. Downs Syndr Res Pract 2007; 12(1): 72-77.
38. Kumar S, Sharma J, Duraiswamy P, Kulkarni S: Determinants for oral hygiene and periodontal status amoung mentally disabled children and adolescents. J Indian Soc Pedod Prevent Dent 2009; 3(27): 151-157.
39. Teitelbaum AP Pochapski MT, Jansen JL et al.: Evaluation of the mechanical and chemical control of dental biofilm in patients with Down syndrome. Community Dent Oral Epidemiol 2009; 37: 463-467.
40. Al Habashneh R, Al-Jundi S, Khader Y, Nofel N: Oral health status and reasons for not attending dental care among 12- to 16-year-old children with Down syndrome in special needs centres in Jordan. Int J Dent Hyg 2012; 10: 259-264.
41. Bradley C, McAlister T: The oral health of children with Down syndrome in Ireland. Spec Care Dentist 2004; 24(2): 55-60.
42. De Jongh A, Van Houtem C, Van Der Schoof M et al.: Oral health status, treatment needs, and obstacles to dental care among noninstitutionalized children with severe mental disabilities in The Netherlands. Spec Care Dentist 2008; 28(3): 111-115.
43. Pels E: Ocena stanu higieny jamy ustnej i stanu przyzębia u dzieci z zespołem Downa. Przegl Stom Wieku Rozw 1999; 25(1): 14-17.