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

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**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 actinomycetemcomitans* 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 statistically using the chi-square test, Pearson correlation coefficient and analysis of variance. The level of significance was p ≤ 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

<table>
<thead>
<tr>
<th>Indices</th>
<th>Study group x ± SD</th>
<th>Control group x ± SD</th>
<th>Significance of differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>mSBI (%)</td>
<td>70.9 ± 27.65</td>
<td>26.69 ± 34.94</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>GI</td>
<td>0.90 ± 0.56</td>
<td>0.39 ± 0.53</td>
<td>p &lt; 0.001</td>
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</tbody>
</table>

Tab. 1. Periodontal status

Ryc. 1. Frekwencja zapaleń przyzębia

100%

Patients

Healthy periodontium

85.3%

Healthy controls

Periodontitis

14.7%

p < 0.001

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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

<table>
<thead>
<tr>
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<th>Study group x ± SD</th>
<th>Control group x ± SD</th>
<th>Significance of differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>OHI-S</td>
<td>1.68 ± 0.68</td>
<td>1.32 ± 0.76</td>
<td>p &lt; 0.01</td>
</tr>
<tr>
<td>DI-S</td>
<td>1.58 ± 0.65</td>
<td>1.17 ± 0.65</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>CI-S</td>
<td>0.10 ± 0.14</td>
<td>0.16 ± 0.28</td>
<td>NS</td>
</tr>
<tr>
<td>API (%)</td>
<td>86.66 ± 17.78</td>
<td>66.34 ± 34.33</td>
<td>p &lt; 0.001</td>
</tr>
</tbody>
</table>

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)
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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 values 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