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A Detailed Analysis of Oral Hygiene Habits of Patients with Cervical Dental Lesions

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ABSTRACT

Objectives: Studying oral hygiene habits of patients with cervical dental lesions; identifying differences in dental health depending on characteristics of oral hygiene care.

Materials and Methods: The study enrolled 272 patients being fully examined to diagnose cervical dental lesions: I – with a wedge-shaped defect (WSD), II – with erosion, III – with cervical caries (CC), IV – with a combination of cervical dental lesions, V – without any cervical dental lesions. The patients filled in the survey/questionnaire with information about their hygienic care. We identified Decayed, Missing and Filled Teeth index (DMFT), Papillary bleeding index (PBI), papillary-marginal-alveolar index (PMA), Oral Hygiene Index Simplified (OHI-S), level of personal anxiety, presence of dentin hypersensitivity (DH), wear facets.

Results: When brushing teeth twice daily or more often, patients of Group I had less DMFT; OHI-S indicators were lower in mixed toothbrush motions; when using whitening toothpaste, probability of wear facets often ($p \leq 0.05$). Application of pressure to a toothbrush was associated with level of personal anxiety; contributed to WSD development and increase in their number and PBI indicators ($p<0.05$). When brushing teeth after breakfast, the depth of lesions was less in patients of Group II ($p=0.039$). Probability of development of wear facets increased in subjects of Group III when duration of tooth brushing was three minutes or longer and PBI indicators increased; when flossing and brushing teeth for three minutes or longer, DH was diagnosed more while PMA indicators decreased when brushing teeth three or more times daily ($p<0.05$). Patients of Group IV flossed more aggressively and brushed in a circular motion less frequently than patients with CC ($p<0.05$). Flossing reduced probability of CC; dominance of mixed or circular toothbrush motions reduced probability of CC and associated lesions ($p<0.05$).

Conclusions: Identified differences in oral hygiene habits of patients with cervical dental lesions are recommended to take into account when planning preventive measures.

Keywords: dental caries, dentine hypersensitivity, erosion, non-carious cervical lesions

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Introduction

Dental caries remains an actual problem of dental health despite modern scientific achievements.[1] Prevalence of its numerous forms varies from 67 to 100% among almost all age and sex groups of the population.[2] The World Health Organization (WHO) has recently classified dental caries as a non-infectious disease closely related to individual behavior and lifestyle.[1] Therefore, timely and effective comprehensive preventive measures, especially in cervical localization of the pathology, will contribute to a significant reduction in its prevalence, avoiding complications and development of periodontal diseases, gingival recession (GR) and dentin hypersensitivity (DH).[2]

Non-carious cervical lesions (NCCL) are the second most common reason for treatment of permanent teeth after caries, especially among adults who are over 40 years of age. Their prevalence varies from 10 to 90% and increases with age.[3] A further increase in this indicator is expected along with an increase in the period of functioning of the teeth due to an increase in life expectancy. This emphasizes the need for preventive measures at an earlier age to avoid invasive treatment in the future.[4] In this regard, it is important to understand the causes of development, progression and combination of cervical dental lesions at the individual level.[5] These days more and more attention is paid to social and behavioral determinants of oral health.[6] Most modern researchers consider the etiology of cervical dental lesions to be multifactorial, completely unexplained and related to patients' habits including hygienic ones.[3,4,7-13] Therefore, in addition to careful history taking, it is essential to analyze individual oral hygiene habits and

their correlations in order to change them, control such changes and improve the patient's quality of life.[4,12,14]

Tooth brushing habit plays an important role in development, distribution and structure of cervical dental lesions.[15] The pathological picture of NCCL differs from caries and is mainly associated with such processes as erosion and abrasion that is associated with chronic mechanical trauma being characteristic of tooth brushing.[5,11] Abrasion with a toothbrush is also affected by the pressure with which the patient uses it, the duration and frequency of hygiene procedures.[3,15,16] Tooth brushing technique and stiffness of toothbrush bristles, that are correlated with clinical development and severity of NCCL, are of great importance.[17] The majority of patients with NCCL is known to use a horizontal tooth brushing technique.[3,18] Horizontal and vertical scratches detected on the tooth surfaces with the help of scanning electron microscopy can be the result of appropriate motions of a toothbrush, and uneven scratches - the result of incorrect or circular motions of a toothbrush. It is possible that these defects are the result of long-term unidirectional abrasion.[19] According to,[3,7,20] excessive and horizontal tooth brushing technique can cause a wedge-shaped defect (WSD). Other researchers have linked susceptibility to erosion and abfraction to tissue destruction at the cemento-enamel junction due to such physiological activities as tooth brushing and chewing.[21] The acid produced by dental plaque can also disrupt the mechanical properties of enamel and dentin in cemento-enamel junction area to such an extent that they will be susceptible to abrasion by a toothbrush that will subsequently lead to development of NCCL.[22] In addition, tooth brushing, especially with application of pressure, may cause DH symptoms that are common in patients with NCCL.[23,24] But there are also such known studies that did not confirm the existence of correlations between development and localization of erosive tooth wear and WSD and various hygienic factors.[10,25] It is also possible that ordinary hygienic procedures by themselves do not cause significant wear of tooth enamel.[16] This confirms the well-known fact that carious and non-carious dental lesions occur in people who have no access to hygienic means.[26]

Thus, today there are opposite opinions and research results regarding the role of oral hygiene habits in the development of cervical dental lesions. In addition, most of available information is related to NCCL, often has a generalizing nature and is not specified for cervical caries (CC), WSD and erosion that is not sufficient for their practical application. So, it is important to identify each type of lesion during clinical examination in order to recognize individual etiological factors for prescribing effective preventive measures.[9,13,27] In our opinion, special attention should be paid to young patients in whom exposure to potential etiological factors will help reduce the prevalence and progression of cervical dental lesions. The aim of the research is to study oral hygiene habits of young patients having cervical dental lesions; identifying potential differences in their dental health depending on the characteristics of oral hygiene care.

Materials and Methods

Ethical Consideration

The research was carried out based on the principles of WMA Declaration of Helsinki Ethical Principles for Medical Research Involving Human Objects as amended in 2013, Order No. 690 of the Ministry of Health of Ukraine (dated September 23, 2009) and approved by the Bioethics Commission (No 43, dated January 21, 2021). All participants were given written informed consent before the study.

Participants and Study Design

The study enrolled 272 patients (174 women and 98 men) aged 18-44 years (average age 24.3±6.9 years). Based on the classification of the WHO (2016)[28] there were such qualifying criteria as young age, absence of harmful habits, pregnancy and lactation period; neoplasms.

A practitioner-dentist performed a clinical check-up of hard dental tissues for the presence of NCCL and CC. NCCL was classified under their morphology (WSD and erosion). We diagnosed WSD, erosion and occlusal/incisal wear facets according to the Tooth Wear Index (TWI) by B.G. Smith, J.K. Knight based on William's periodontal probe (Trinity®).[4] The TWI uses a scale from 0 to 4, where 0 - no change in contour, 1 - minimal loss of contour, 2 - defect, 1 mm deep, 3 - depth of defect between 1 mm and 2 mm, and 4 - depth of defect 2 mm or exposure of secondary dentin or pulp.[4] A caries marker Izumrud (Latus, Ukraine) was applied to diagnose CC.

Patients filled in the survey/questionnaire answering the questions about oral hygiene habits (frequency, duration, force, and tooth brushing technique; carrying out hygiene procedures in the morning depending on the meal, type of a toothbrush (manual or electric); use of whitening toothpaste and additional hygiene products (floss, brushes, irrigator, etc.). Dominant motions of a toothbrush mentioned in the survey/questionnaire were proven in front of a dentist during control tooth brushing. Tooth brushing was considered intensive, and the use of additional hygiene products was thought aggressive according to the patient's self-assessment that was confirmed by a change in the appearance of the working surface of a toothbrush (bristle condition) or the working part of additional hygiene products.

The survey/questionnaire form included both proposed answer options and own responses. The list of oral hygiene habits from the survey/questionnaire was related to subjects' area of residence and socio-economic characteristics. Patients were provided with explanations on any questions that arose during its filling.

The intensity of dental caries was identified according to Decayed, Missing and Filled Teeth index (DMFT), the severity of the inflammatory process in the periodontal tissues - according to the papillary-marginal-alveolar index (PMA) by S. Parma, bleeding gums - according to Papillary

Bleeding Index (PBI) by H.R. Mühlemann, GR - using William's periodontal probe (Trinity®).[29] The state of oral hygiene was assessed based on Oral Hygiene Index Simplified (OHI-S) by J. Greene, J. Vermillion.[30] We diagnosed DH carrying out probing tooth surfaces (tactile test) and air blast and cold water tests from a triple syringe.[17,23] In order to make a diagnosis of the psycho-emotional state we identified personal anxiety with the help of Ch.D. Spielberger State-Trait-Anxiety-Inventory (STAI) in the adaptation of Y.L. Khanina.[23]

Statistical Analysis

Statistical analysis was carried out with the help of the Statistica 12.0 computer program (3BA94C4ED07A) software for Windows (IBM corp., Armonk, NY, USA). By comparing average indicators in normally distributed populations, Student's t-test was calculated. The differences were thought to be statistically significant at $p \leq 0.05$. Nominal data were compared with the help of Pearson's χ^2 test. In cases where the number of expected trials was less than 5, Fisher's test was applied to evaluate the level of significance of differences. The relationship between indicators was calculated using non-parametric Spearman's rank coefficient (r).

Results

We made a diagnosis of cervical dental lesions in 43.4% of subjects: 72 women (41.4%) and 46 men (46.9%).[23] Taking into account the presence and type of cervical dental lesions patients' distribution is presented in Figure 1. All erosive defects were within the enamel. We revealed the combination of cervical dental lesions in 7 subjects: 5 cases - erosion with WSD, 2 cases - erosion with CC.[23] Taking into consideration the results of the clinical check-up, all patients were divided into five groups: I – with WSD, II – with erosion of enamel, III – with CC, IV – with a combination of cervical dental lesions, V – without any cervical dental lesions. We did not find any difference in patients' age depending on the study group ($p>0.05$).[23] TWI indicators of teeth with WSD and occlusal/incisal wear corresponded to grades 1-3, teeth with erosion – grades 1-2. During previous studies, some indicators of dental health and the presence of complaints of feeling of bad breath in the mouth were determined in subjects.[8,31]

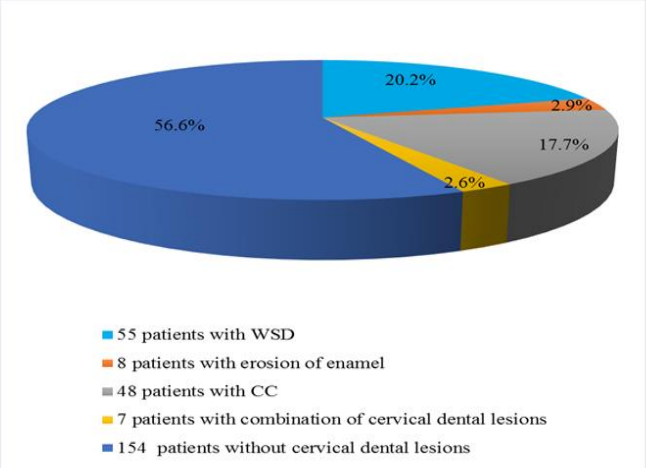

***Figure 1**. Patients' distribution based on the results of clinical check-up*

Analysis of Oral Hygiene Habits

Common oral hygiene habits among subjects are shown in Table 1 and Figure 2. They do not present those oral hygiene habits that were episodic in nature or were present in a small number of patients, so they were not taken into account during the analysis. The studied oral hygiene habits did not depend on subjects' age ($p>0.05$). Patients performed hygiene procedures before or after breakfast almost equally often. But under the condition of tooth brushing after eating, the degree of TWI was significantly lower in teeth with erosion ($\chi^2=4.286$, $p=0.039$).

Subjects used whitening toothpaste, on average, for 0.40±1.23 years. In patients with WSD, this period was longer (0.56±1.49 years, $p>0.05$), but significant differences were identified only between Group III (0.12±0.38 years) and Group IV (0.01±0.04 years), ($t=1.97$, $p<0.05$). Subjects flossed, on average, for 0.81±2.13 years. Although there was no statistically significant difference, patients in Group II flossed for a longer time (2.0±5.3 years, $p>0.05$). It was determined that women chose floss and whitening toothpaste as hygiene products significantly more often than men ($\chi^2=8.33$, $p=0.003$ and $\chi^2=3.80$, $p=0.05$, respectively).

When brushing their teeth, patients with WSD applied more pressure to a toothbrush than patients with CC and without cervical lesions ($\chi^2=4.716$, $p=0.030$ and $\chi^2=8.176$, $p=0.05$, respectively). Intensive tooth brushing influenced the development of WSD and an increase in their number ($\chi^2=7.281$, $p=0.007$ and $\chi^2=9.045$, $p=0.003$, respectively).

Subjects of Group III flossed more often as an additional hygiene product compared to the subjects of Group V ($\chi^2=4.147$, $p=0.042$). It was determined that under the condition of flossing, probability of CC development decreased ($\chi^2=4.813$, $p=0.029$). Patients with WSD and associated cervical dental lesions flossed

aggressively significantly more often compared to patients with CC (χ^2=4.365, p=0.037 and χ^2=7.270, p=0.008, respectively).

A greater number of subjects (68.8%) brushed their teeth twice daily (Table 2 and Figure 3) and used manual medium-hard toothbrushes for individual hygiene (87.9%), p>0.05 (Table 3 and Figure 4). Although there was no statistically significant difference, patients with clinical symptoms of DH also chose a toothbrush with medium-hard bristles more often (p>0.05).

The majority of patients (89.3%) indicated mixed motions of a toothbrush as the main technique for tooth brushing (Table 4 and Figure 5). Subjects with WSD made horizontal motions more often (χ^2=5.458, p=0.02), but that did not affect their development (χ^2=0.051, p=0.822). Significant differences in tooth brushing technique were also observed between patients of Group III and Group IV as well as Group III and Group V. When brushing their teeth subjects with CC made circular movements with a brush more often than subjects with combined cervical dental lesions and without cervical dental lesions (χ^2=6.984, p=0.009 and χ^2=3.976, p=0.047, respectively). In case of dominance of mixed or circular motions, there was a lower probability of CC or combined forms of dental lesions (χ^2=4.130, p=0.043 and χ^2=52.801, p<0.001, respectively).

The average duration of tooth brushing was 2.64±1.29 minutes. Although there was no statistically significant difference, its higher values (2.72±1.37 minutes) were identified in subjects of Group V (p>0.05).

Table 1. *Comparison of study groups by prevalence of oral hygiene habits*

Oral hygiene habits	Sex	Total by sex (abs./% of the total number of patients of this sex)	Groups (abs./% of the total number of patients in the group)				
			I	II	III	IV	V
Tooth brushing before breakfast	m	52/53	14/25	2/25	9/19	0/0	27/18
	w	85/49	15/27	4/50	15/3	4/57	47/31
		p-value	p_2=0.125	p_1=0.125	p_1=0.973	p_1=0.784	p_1=0.552
			p_3=0.973	p_3=0.317	p_2=0.317	p_2=0.666	p_2=0.138
			p_4=0.784	p_4=0.666	p_4=0.799	p_3=0.799	p_3=0.814
			p_5=0.552	p_5=0.138	p_5=0.814	p_5=0.638	p_4=0.638
Tooth brushing after breakfast	m	45/46	8/14	0/0	11/22	1/14	25/16
	w	90/52	18/32	2/25	13/27	2/28	55/35
		p-value	p_2=0.223	p_1=0.223	p_1=0.408	p_1=0.192	p_1=0.552
			p_3=0.408	p_3=0.492	p_2=0.492	p_2=0.485	p_2=0.138
			p_4=0.192	p_4=0.485	p_4=0.291	p_3=0.291	p_3=0.814
			p_5=0.552	p_5=0.138	p_5=0.814	p_5=0.638	p_4=0.638
Application of pressure to a toothbrush	m	22/22	9/16	0/0	1/2	0/0	12/8
	w	31/18	10/18	2/25	5/10	1/14	13/8
		p-value	p_2=0.375	p_1=0.375	p_1=0.030*	p_1=0.342	p_1=0.005*
			p_3=0.030*	p_3=0.573	p_2=0.573	p_2=0.747	p_2=0.517
			p_4=0.342	p_4=0.747	p_4=0.984	p_3=0.984	p_3=0.531
			p_5=0.005*	p_5=0.517	p_5=0.531	p_5=0.892	p_4=0.892
Use of whitening toothpaste	m	11/11	3/5	0/0	5/10	0/0	3/2
	w	36/21	8/15	1/13	1/2	1/14	25/16
		p-value	p_2=0.630	p_1=0.630	p_1=0.516	p_1=0.778	p_1=0.767
			p_3=0.516	p_3=0.948	p_2=0.948	p_2=0.952	p_2=0.683
			p_4=0.778	p_4=0.952	p_4=0.576	p_3=0.576	p_3=0.359
			p_5=0.767	p_5=0.683	p_5=0.359	p_5=0.794	p_4=0.794
Flossing	m	17/17	3/5	0/0	3/6	0/0	11/7
	w	61/36	13/24	2/25	5/10	3/43	38/25
		p-value	p_2=0.902	p_1=0.902	p_1=0.058	p_1=0.551	p_1=0.453
			p_3=0.058	p_3=0.142	p_2=0.142	p_2=0.666	p_2=0.687
			p_4=0.551	p_4=0.666	p_4=0.092	p_3=0.092	p_3=0.042*
			p_5=0.453	p_5=0.687	p_5=0.042*	p_5=0.542	p_4=0.542
Aggressive flossing	m	3/3	0/0	0/0	0/0	0/0	3/2
	w	13/7	4/7	0/0	0/0	1/14	8/5
		p-value	p_2=0.832	p_1=0.832	p_1=0.037*	p_1=0.602	p_1=0.975
			p_3=0.037*	p_3=0.066	p_2=0.066	p_2=0.563	p_2=0.412
			p_4=0.602	p_4=0.563	p_4=0.008*	p_3=0.008*	p_3=0.057
			p_5=0.975	p_5=0.412	p_5=0.057	p_5=0.482	p_4=0.482

w: - women; m: – men; abs. – absolute value; p_1- the statistically significant of differences when comparing the corresponding study group with Group I; p_2 - the statistically significant of differences when comparing the corresponding study group with Group II; p_3 – the statistically significant of differences when comparing the corresponding study group with Group III; p_4 – the statistically significant of differences when comparing the corresponding study group with Group IV; p_5 - the statistically significant of differences when comparing the corresponding study group with Group V; * - p≤0.05.

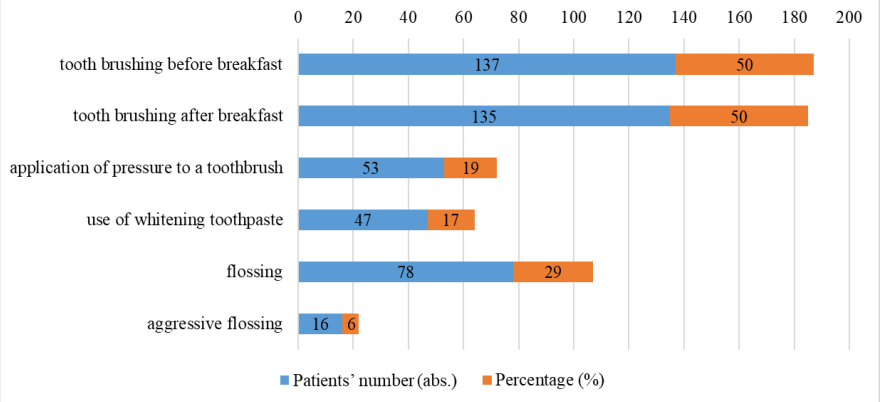

Figure 2. *Prevalence of oral hygiene habits among subjects*

Table 2. *Comparison of study groups by frequency of tooth brushing daily with a manual toothbrush*

Groups	Sex	Frequency of tooth brushing daily (abs./% of the total number of patients in the group)			p-value
		One	Two	Three	
I	m	9/16.0	13/23.0	0/0	p_2=0.474
	w	7/13.0	24/44.0	2/4.0	p_3=0.853
					p_4=0.432
					p_5=0.655
II	m	0/0	2/25.0	0/0	p_1=0.474
	w	2/25.0	4/50.0	0/0	p_3=0.432
					p_4=0.499
					p_5=0.952
III	m	7/14.6	12/25.0	1/ 2.1	p_1=0.853
	w	6/12.5	21/43.7	1/ 2.1	p_2=0.432
					p_4=0.591
					p_5=0.879
IV	m	0/0	1/14.3	0/0	p_1=0.624
	w	0/0	6/85.7	0/0	p_2=0.499
					p_3=0.591
					p_5=0.120
V	m	22/14.2	29/18.8	1/0.01	p_1=0.655
	w	18/11.7	75/48.7	9/6.0	p_2=0.952
					p_3=0.879
					p_4=0.120

w: – women; m: – men; abs. – absolute value; p_1- the statistically significant of differences when comparing the corresponding study group with Group I; p_2 - the statistically significant of differences when comparing the corresponding study group with Group II; p_3 – the statistically significant of differences when comparing the corresponding study group with Group III; p_4 – the statistically significant of differences when comparing the corresponding study group with Group IV; p_5 - the statistically significant of differences when comparing the corresponding study group with Group V

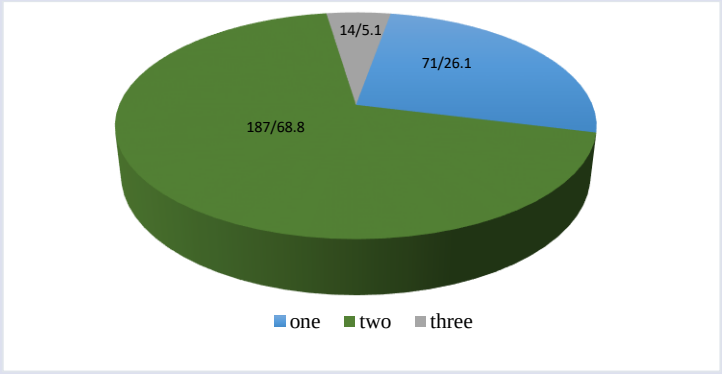

Figure 3. *Frequency of tooth brushing daily with a manual toothbrush by subjects (times) (abs./%)*

Table 3. *Comparison of study groups by type of a manual toothbrush stiffness*

Groups	Sex	Toothbrush stiffness (abs./% of the total number of patients in the group)			p-value
		Soft	Medium-hard	Hard	
I	m	2/4.0	19/34.5	1/ 2.0	p_2=0.615
	w	2/4.0	31/56.3	0/0	p_3=0.897
					p_4=0.731
					p_5=0.257
II	m	0/0	2/25.0	0/0	p_1=0.615
	w	0/0	6/75.0	0/0	p_3=0.389
					p_4=0.489
					p_5=0.495
III	m	2/4.0	18/37.5	0/0	p_1=0.897
	w	5/10.4	22/46.0	1/ 2.0	p_2=0.389
					p_4=0.706
					p_5=0.325
IV	m	0/0	1/14.3	0/0	p_1=0.731
	w	0/0	6/85.7	0/0	p_2=0.489
					p_3=0.706
					p_5=0.555
V	m	0/0	47/30.5	5/3.2	p_1=0.257
	w	11/7.1	87/56.5	4/2.6	p_2=0.495
					p_3=0.325
					p_4=0.555

w: – women; m: – men; abs. – absolute value; p_1- the statistically significant of differences when comparing the corresponding study group with Group I; p_2 - the statistically significant of differences when comparing the corresponding study group with Group II; p_3 – the statistically significant of differences when comparing the corresponding study group with Group III; p_4 – the statistically significant of differences when comparing the corresponding study group with Group IV; p_5 - the statistically significant of differences when comparing the corresponding study group with Group V

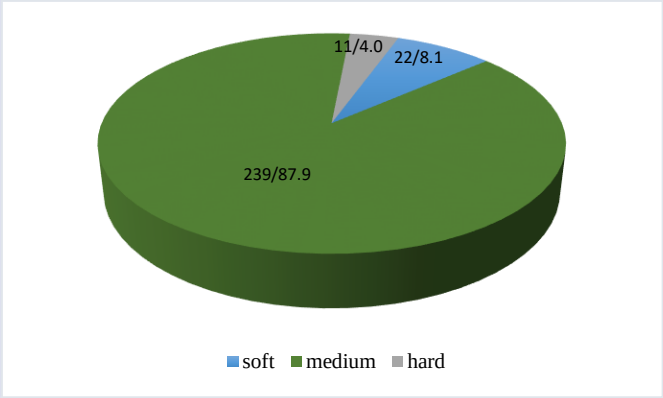

Figure 4. *The type of a manual toothbrush stiffness in subjects (abs./%)*

Table 4. *Comparison of study groups by tooth brushing technique*

Groups	Sex	Dominant motions of a toothbrush (abs./% of the total number of patients in the group)				p-value
		Horizontal	Vertical	Circular	Mixed	
I	m	1/1.8	1/1.8	1/1.8	19/34.5	p_2=0.331
	w	2/3.6	2/3.6	0/0	30/54.5	p_3=0.020*
						p_4=0.126
						p_5=0.480
II	m	0/0	0/0	0/0	2/25.0	p_1=0.331
	w	0/0	0/0	1/12.5	5/62.5	p_3=0.684
						p_4=0.269
						p_5=0.412
III	m	0/0	0/0	1/2.0	19/39.5	p_1=0.020*
	w	0/0	0/0	2/4.0	26/54.2	p_2=0.684
						p_4=0.009*
						p_5=0.047*

IV	m	0/0	0/0	0/0	5/71.6	p_1=0.126
	w	0/0	1/14.2	0/0	1/14.2	p_2=0.269
						p_3=0.009*
						p_5=0.538
V	m	5/3.2	1/0.01	3/2.0	43/28.0	p_1=0.480
	w	3/2	3/2	2/1.3	93/60.4	p_2=0.412
						p_3=0.047*
						p_4=0.538

*w: - women; m: – men; abs. – absolute value; p_1- the statistically significant of differences when comparing the corresponding study group with Group I; p_2 - the statistically significant of differences when comparing the corresponding study group with Group II; p_3 – the statistically significant of differences when comparing the corresponding study group with Group III; p_4 – the statistically significant of differences when comparing the corresponding study group with Group IV; p_5 - the statistically significant of differences when comparing the corresponding study group with Group V; * - p≤0.05.*

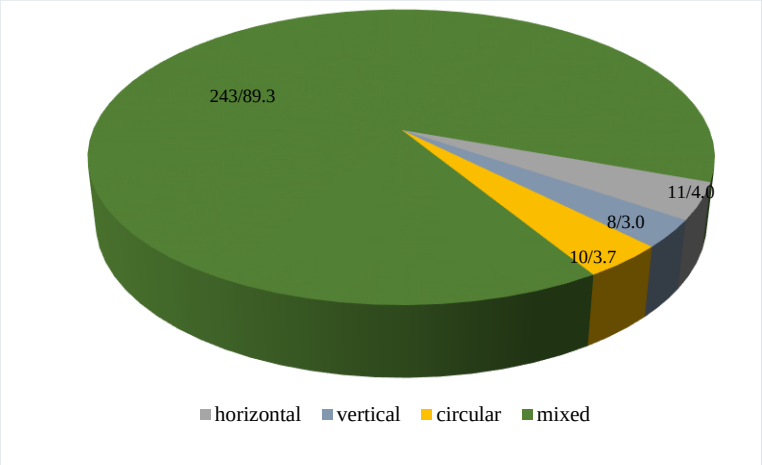

Figure 5. *Dominant motions of a manual toothbrush during tooth brushing by subjects (abs./%)*

Identification of Potential Differences in Dental Health Status Depending On the Peculiarities of Oral Hygiene Practice

In Group 1, DMFT indicators differed depending on the frequency of tooth brushing (χ^2=11.757, p<0.001). Thus, when patients with WSD brushed their teeth twice daily or more, DMFT indicators reliably decreased. PBI indicators increased significantly in patients of Group I under the condition of applying more pressure to a toothbrush during tooth brushing (χ^2=9.006, p=0.003), and in patients of group III - under the condition when the duration of the hygienic procedure was three minutes or longer (χ^2=5.855, p=0.016). PMA indicators differed depending on the frequency of tooth brushing in patients with CC (χ^2=5.319, p=0.022). Thus, when the number of procedures during the day was three or more, PMA indicators decreased significantly.

There was determined the influence of oral hygiene habits on the development of DH in subjects of Group I. The probability of developing clinical symptoms of DH differed depending on flossing and duration of tooth brushing in patients with WSD (χ^2=4.491, p=0.035 and χ^2=5.620, p=0.018, respectively). So, when patients flossed and brushed their teeth for three minutes or longer, DH was diagnosed more often. It was previously reported that degrees of TWI affected the development of symptoms of DH (in teeth with WSD – significantly - χ^2=8.17, p=0.04, in teeth with erosion - nonsignificantly - χ^2=5.60, p=0.06).[23] The conducted analysis has shown that the pressure applied to a toothbrush by a patient varies depending on their psycho-emotional state (χ^2=7.765, p=0.006). In subjects with associated cervical dental lesions, a moderate direct correlation was observed between the level of personal anxiety and indicators of PMA and OHI-S (r=0.59 and r=0.38, p<0.05, respectively).

In subjects of Group 1, the level of oral hygiene differed depending on tooth brushing technique (χ^2=3.71, p=0.05). Patients with WSD had a better state of hygiene when using mixed motions of a manual toothbrush. The development of occlusal/incisal wear facets was influenced by the characteristics of oral hygiene care. The probability of their development increased in subjects with CC when the duration of tooth brushing was three minutes or longer (χ^2=4.324, p=0.038), in subjects with WSD - when using whitening toothpaste (χ^2=4.626, p=0.032). None of the considered oral hygiene habits had significant differences in patients with GR. Flossing significantly affected the presence of complaints of feeling of bad breath in the mouth in those subjects with associated cervical dental lesions (χ^2=3.73, p=0.05).

Discussion

Regular tooth brushing can be attributed to socio-economic factors.[11] Independent daily mechanical destruction and plaque removal are important for the

health of the oral cavity. A significant number of subjects preferred a manual toothbrush among the means of oral hygiene, 29% of patients used dental floss as an additional hygiene tool. Therefore, the analysis was focused on these individual oral hygiene habits. According to,[32] a manual toothbrush can remove up to 43% of dental plaque on average. So, it is recommended to use additional means to penetrate the interdental spaces.[33]

There are studies that determined a reliable correlation between age, sex and oral hygiene habits.[12] The researchers did not find any correlation between age and oral hygiene habits, probably, because only young patients were examined. But women used floss and whitening toothpaste significantly more often. Individual oral hygiene in women is known to be at a higher level that also contributes to a higher prevalence of NCCL and DH because of traumatic tooth brushing techniques.[24,34] But other scientists did not find a significant correlation between sex and oral hygiene habits in patients with erosion.[35] According to,[9] different research results are probably due to the fact that sex and age factors can explain only a small percentage of differences in tooth wear.

The presence of NCCL is known to be associated with the use of toothpaste.[18] At the same time, the abrasiveness of toothpaste is of great importance.[7,15,16] Subjects used whitening toothpaste for a short period of time, although even under these circumstances, differences in the prevalence of occlusal/incisal wear facets were identified in patients with WSD. The obtained results are consistent with the data,[27] according to which abrasion of hard dental tissues occurs due to interactions between teeth and exogenous substances, such as highly abrasive toothpastes, especially with whitening effect. The researchers determined that patients with WSD also flossed aggressively more often that, according to,[16] is a likely cause of NCCL.

The time of tooth brushing is known to have different effects on their wear, because the erosive effect makes hard tissues more susceptible to loss because of abrasion.[9] But no evidence has been found yet that waiting a certain period of time after breakfast before tooth brushing affects the degree of tooth wear.[36] The study revealed that the depth of erosion was significantly lower in patients who brushed their teeth after eating. The degree of TWI in tooth with erosion was significantly lower.

The stiffness of toothbrush bristles can affect tooth wear in different ways.[9] Manual hard bristle toothbrushes remove dental plaque better, but can also cause more trauma to soft tissues.[37,38] And the use of medium or hard bristle toothbrushes and application of greater pressure during tooth brushing can increase dentin wear.[15,27] Therefore, increased application of pressure to a toothbrush is also associated with development of NCCL,[39] and their prevention involves reducing this effect.[40] The conducted analysis has determined that the pressure applying to a toothbrush by a patient differs depending on their psycho-emotional state. Other researchers proved that tooth wear and WSD were diagnosed three times more often in subjects with a high level of anxiety.[41] In patients with combined cervical dental lesions, correlation was observed between the level of personal anxiety and the indicators of PMA and OHI-S. Increased psychoemotional stress significantly worsens the condition of periodontal tissues that is confirmed by an increase in the indicators of periodontal indices.[42] Therefore, the examination of patients with cervical dental lesions should be comprehensive and include both an assessment of dental and psycho-emotional states.[23]

Patients with WSD brushed their teeth intensively that increased the number of lesions and PBI indicators. According to,[43] half of subjects with WSD brush their teeth from three to five minutes. In patients with CC, PBI indicators increased and occlusal/incisal wear facets developed when tooth brushing lasted for three minutes or longer. Therefore, the researchers recommend not exceeding the time of the hygienic procedure more than 2.5 minutes. RBI indicators varied depending on OHI-S indicators.[31] There is a strong correlation between hygiene indices and the development of periodontal pathology.[42,44] Therefore, it is important to teach patients the correct technique of tooth brushing in order to reduce the wear of toothbrush bristles and increase its efficiency.[32]

Patients with NCCL are known to brush their teeth significantly more often,[45] most of them brush their teeth twice daily.[41] Other researchers found an insignificant correlation between NCCL and frequency of tooth brushing.[46] It was determined that frequency of tooth brushing twice or more times daily contributed to a decrease in DMFT indicators in patients with WSD and to a decrease in PMA indicators in patients with CC who brushed teeth three or more times daily. There are also associations between oral hygiene and the etiology of WSD.[46] The conducted analysis identified that the most effective motions were mixed or circular ones of a manual toothbrush.

According to,[33] additional flossing can reduce the amount of dental plaque and, accordingly, the severity of gingivitis. This confirms the obtained results, namely the positive effect of flossing on the appearance of complaints of feeling of bad breath in the mouth in patients with combined cervical dental lesions. The conducted study also showed that the probability of CC development was reduced in those subjects who flossed. However, patients with WSD and combined cervical dental lesions used it more often in an aggressive technique. It contributed to development of clinical symptoms of DH in subjects with WSD, because aggressive flossing is likely to cause tooth wear.[14,27]

Possible etiological factors of DH are tissue abrasion with a hard bristle toothbrush.[47] In the present study, a greater number of patients with DH used a medium bristle toothbrush. No differences in the development of DH were identified depending on the frequency and technique of daily tooth brushing and the time of hygienic procedures after breakfast, as in other studies.[47] When

brushing teeth for 3 minutes and longer as well flossing, DH was diagnosed patients with WSD with more often. According to,[21] flossing was not associated with self-reported DH. Typical toothpastes alone cannot cause DH, but toothpastes with higher abrasiveness or abnormal tooth brushing can contribute to development of its symptoms due to dentin wear and the removal of the lubricated layer and development of open dentinal tubules.[15] According to data,[48] oral hygiene habits were not reliably associated with development of GR that confirmed the conducted study.

Therefore, it is not always possible to find any excessive hygienic habits in the histories of patients with WSD and erosion which can lead to development of cervical dental pathology.[7] In addition, they do not always share this information.[5] According to,[39] this can explain only 68.8% of the differences in tooth wear. Although there is no clear evidence of how different forms of NCCL can be related to each other, according to,[7] it is possible to assume that they reflect different stages of progression of the lesion, local factors play a role only in changing their form. Therefore, preventive intervention begins with individual counseling on changing the patient's attitude, for example, towards the method of tooth brushing.[13]

There were some limitations in the conducted study. To begin with, 64% of subjects were women; then, the sample was represented by young patients living in a definite geographic area and having oral hygiene habits peculiar to it; finally, after the comprehensive examination significant differences in number in the formed study groups were observed. Some differences are probably related to subjects' age, their socio-economic and cultural factors, habits in hygienic means, as well as in the exclusive trust of data obtained from questionnaires.[49] It is also impossible to consider the information got from surveys/questionnaires as completely objective. All this limits the generalization of the obtained results.

Conclusions

The conducted study revealed significant differences in the considered dental health indicators of patients with cervical dental lesions depending on the characteristics of oral hygiene habits. The obtained results are recommended to take into account when planning individual treatment and preventive measures, especially in young patients, in order to prevent the development, progression and combination of oral pathology.

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