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REASONS FOR PRIMARY TEETH EXTRACTION IN CHILDREN AGED 1-14 YEARS: A RETROSPECTIVE STUDY

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Summary

Early primary teeth extraction decrease children's quality of life, promote malocclusion, speech disturbance, gastro-intestinal disease.

Aim: to study the reasons for primary teeth extraction, analyze the types of extracted primary teeth and propose the measures for prevention of early primary teeth loss in children.

Materials and methods. Retrospective study was conducted in a paediatric dental clinic in Volgograd. Randomly selected medical records of 100 paediatric patients aged 1-14 years with 347 extracted primary teeth were studied. Every case of tooth extraction was analyzed taking into account the type of a tooth, the reason for extraction, the previous treatment, and the data of radiographic examination. The proportions (%) and 95% Confidence Interval (CI) were calculated; chi-square test was used for the differences assessment at p-value < 0.05.

Results. The main reasons for the primary tooth extractions were caries sequelae – 69.2% (95% CI 64.1-73.8%), C-group, followed by the disturbances in permanent tooth eruption – 30.0% (95% CI 25.2-35.1%), O-group, and trauma – 0.9% (95% CI 0.2-2.5%), T-group. The most common extracted primary teeth in C-group were molars (87.4%, 95%CI 82.7-91.1%), in O-group – incisors (61.5%, 95% CI 51.9-70.3%). The differences between the distribution of extracted teeth types in C- and O-groups were significant statistically ($p<0.001$). In total the first molar was the most frequently extracted primary tooth. Previously treated and untreated teeth were equally registered among the teeth in C-group. The majority of them had carious lesions on 2 (54.2%, 95% CI 47.7-60.5%) or more surfaces (36.6%, 95% CI 30.1-42.5%), pathological root resorption (69.6%, 95% CI 63.0-75.4%); extensive radiolucency in periapical and furcation areas was revealed in all the cases. In C-group 47.5% (95% CI 41.0-54.0%) of the teeth were extracted due to pulpitis treatment failure; the most 98.2% (95% CI 93.8-99.5%) of them had restoration loss, fractures, marginal leakage or secondary caries.

Conclusion. Caries sequelae is the main reason for primary teeth extraction in children and the first primary molar is the most commonly extracted tooth. Early caries detection and treatment, improvement of dental restorations longevity are necessary for the prevention of premature primary teeth loss in children.

Key words: children, primary teeth, extraction, caries sequelae

Introduction

The need for extraction of primary teeth is one of the most common reasons for children's visits to a dental clinic [1,2]. The reasons for primary teeth extraction are various. One of them is overretention of primary teeth which disrupt an eruption of permanent successors in the right place [3]. Another reason for primary teeth extraction is trauma (luxation, extrusion, intrusion, avulsion, crown-root fracture) which often occurs in children in early and preschool ages [1,4,5]. Extremely rarely children need the extraction of natal, neonatal or supernumerary primary teeth [6]. Many children visit an emergency dental clinic with acute toothache, severe inflammation in maxillofacial area due to caries sequelae in primary teeth [7]. Caries and its sequelae are considered the main reason for primary teeth extraction in children [2,8]. Undoubtedly, high caries prevalence and imperfect dental care for children, when the majority of carious lesions remain untreated, contribute to early extraction of primary teeth [9].

Many researchers have notified a high level of early childhood caries prevalence [10,11,12,13]. In dmft-index the proportion of missed (early extracted) primary teeth has increased from 5.7% in 3-year-olds to 9.5% in 6-year-olds [14,15]. Al-Shahrani et al. revealed premature loss of deciduous teeth in 51% of 9-11 years old children [16]. The absence of timely provided dental treatment is the leading cause of early primary teeth extraction [17].

It is known that primary teeth serve as a template for permanent successors which occupy the same place as their predecessors. Therefore, early primary teeth loss and subsequent space reduction is the essential cause of malocclusion development in the childhood [3,16]. Premature primary teeth loss can affect aesthetics, masticatory and speech functions, cause problems in the development of communication skills and socialization of children [3].

The presented data highlight the importance to study the reasons for early primary teeth extraction in dental practice and to reveal the factors which can prevent premature primary teeth loss in children.

Aim: to study the reasons for primary teeth extraction, analyze the types of extracted primary teeth and propose the measures for prevention of early primary teeth loss in children.

Materials and methods

The retrospective study was conducted in a paediatric dental clinic in Volgograd. Randomly selected medical records of 100 paediatric patients aged 1-14 years with 347 extracted primary teeth were analyzed. All tooth extractions were performed with local anesthesia at outpatient surgical appointments.

Every case of tooth extraction was analyzed taking into account the type of teeth, the reason for extraction, the previous treatment, and the data of radiographic examination. The reasons for teeth extraction were the following:

- orthodontic reasons (O-group) included the cases with disturbances in permanent tooth eruption which were caused by a retained primary tooth, diagnosed in accordance with International Classification of Diseases, Tenth Revisions (ICD-10), code K00.6; primary teeth were extracted to make space for the eruption or displacement of a permanent tooth;
- caries sequelae as the reasons (C-group) included cases with apical periodontitis, radicular cyst, periostitis, diagnosed in accordance with ICD-10, codes K04.5, K04.8, K10.2; primary teeth were extracted long before physiological exfoliation to prevent the damage of permanent successor germ and inflammation generalization, eliminate the source of pain and discomfort, eradicate the focus of chronic infection in a child's body;
- teeth injuries (trauma) as the reasons (T-group) included the cases of teeth dislocation, complicated fractures of tooth crown and root, diagnosed according to ICD-10, codes S03.2; after the injuries a primary tooth was extracted when it was impossible to save it.

The programs of Microsoft Office Excel-2007 were used for statistics. The proportions (%) and 95% Confidence Intervals (CI) were calculated. Chi-square test was used to assess the significance of differences between the groups at p-value < 0.05.

Results

The analysis of the medical records revealed that caries sequelae as the reasons for primary teeth extraction were noticed more often than the

disturbances in permanent tooth eruption or dental trauma: 69.2% (95% CI 64.1-73.8%), 30.0% (95% CI 25.2-35.1%) and 0.9% (95% CI 0.2-2.5%) respectively (table 1).

Table 1. The reasons for primary teeth extraction in children

Reasons for extraction	Number and percentage of extracted teeth		
	n	%	95% CI
Caries sequelae	240	69.2	64.1-73.8
Orthodontic	104	30.0	25.2-35.1
Dental trauma	3	0.9	0.2-2.5
Total	347		

Therefore, in outpatient dental practice the frequency of primary teeth extraction due to caries sequelae were 2.3 times higher than the disturbances in permanent tooth eruption and in 76.8 times higher than dental injuries.

Among extracted primary teeth 64.3% (95% CI 59.0-69.3%) of them ha been previously untreated and 35.7% (95% CI 30.7-41.0%) ones had been treated (caries treatment had been performed in 2.0% cases, pulpitis treatment – in 33.7% cases). However, differentiation according to the reasons for extraction showed the other findings (table 2). Untreated teeth (healthy or carious) were revealed in 96.2% (95% CI 90.4-98.9%) cases in O-group and in 50.0% (95% CI 43.5-56.5%) cases in C-group. In T-group all extracted teeth were untreated. In contrast, treated teeth were revealed in O-group only in 3.8% (95% CI 1.1-9.6%) cases and in C-group in 50.0% (95% CI 43.5-56.5%) cases. The differences between O-group and C-group were statistically significant, $p<0.001$. Caries treatment in O-group and C-group was provided in 1.0% (95% CI 0.0-5.2%) and 2.5% (95% CI 0.9-5.4%) cases, $p=0.367$, pulpitis treatment – in 2.8% (95% CI 0.6-8.2%) and 47.5% (95% CI 41.0-54.0%) cases respectively, $p<0.001$.

Table 2. The frequency of treated and untreated teeth in O-, C- and T-groups

Extracted teeth	Number and percentage of the cases							
	O-group		C-group		T-group		Total	
	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)
Untreated	100	96.2* (90.4-98.9)	120	50.0* (43.5-56.5)	3	100 (29.2-100)	223	64.3 (59.0-69.3)
Treated	4	3.8* (1.1-9.6)	120	50.0* (43.5-56.5)	0	0.0	124	35.7 (30.7-41.0)
caries treatment	1	1.0 (0.0-5.2)	6	2.5 (0.9-5.4)	0	0.0	7	2.0 (0.8-4.1)
pulpitis treatment	3	2.8* (0.6-8.2)	114	47.5* (41.0-54.0)	0	0.0	117	33.7 (28.8-39.0)
Total	104		240		3		347	

* the differences between O- and C-group are statistically significant, p<0.001

Therefore, the disturbances in permanent tooth eruption were the reasons for the extraction of mainly untreated primary teeth, whereas caries sequelae were the reasons for the extraction of both treated and untreated primary teeth equally. Pulpitis treatment had been previously provided in the extracted teeth more often than caries treatment.

The age distribution of primary teeth extractions revealed the following patterns (table 3).

Table 3. The distribution of primary teeth extractions in 1-14 years old children

Age, years	Number and percentage of the cases									
	O-group		C-group				T-group		Total	
			Treated teeth		Untreated teeth					
	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)
1	0	0.0 (0.0-1.1)	0	0.0 (0.0-1.1)	4	1.1 (0.4-2.9)	0	0.0 (0.0-1.1)	4	1.1 (0.4-2.9)
2	0	0.0 (0.0-1.1)	0	0.0 (0.0-1.1)	4	1.1 (0.4-2.9)	2	0.6 (0.2-2.1)	6	1.7 (0.8-3.7)

3	0	0.0 (0.0-1.1)	0	0.0 (0.0-1.1)	5	1.4 (0.6-3.3)	0	0.0 (0.0-1.1)	5	1.4 (0.6-3.3)
4	0	0.0 (0.0-1.1)	3	0.9 (0.3-2.5)	9	2.6 (1.4-4.8)	1	0.3 (0.0-1.6)	13	3.7 (2.2-6.3)
5	17	4.9 (3.1-7.7)	13	3.7 (2.2-6.3)	9	2.6 (1.4-4.8)	0	0.0 (0.0-1.1)	39	11.2 (8.3-15.0)
6	16	4.6 (2.9-7.4)	14	4.0 (2.4-6.6)	19	5.5 (3.5-8.4)	0	0.0 (0.0-1.1)	49	14.1 (10.8-18.2)
7	29	8.4 (5.9-11.7)	21	6.0 (4.0-9.1)	18	5.2 (3.3-8.0)	0	0.0 (0.0-1.1)	68	19.6 (15.8-24.1)
8	14	4.0 (2.4-6.6)	26	7.5 (5.2-10.7)	14	4.9 (2.4-6.6)	0	0.0 (0.0-1.1)	57	16.4 (12.9-20.7)
9	8	2.3 (1.2-4.5)	23	6.6 (4.5-9.7)	20	5.8 (3.8-8.7)	0	0.0 (0.0-1.1)	51	14.7 (11.4-18.8)
10	10	2.9 (1.6-5.2)	15	4.3 (2.6-7.0)	10	2.9 (1.6-5.2)	0	0.0 (0.0-1.1)	35	10.1 (7.3-13.7)
11	7	2.0 (1.0-4.1)	2	0.6 (0.2-2.1)	0	0.0 (0.0-1.1)	0	0.0 (0.0-1.1)	9	2.6 (1.4-4.8)
12	2	0.6 (0.2-2.1)	3	0.9 (0.3-2.5)	3	0.9 (0.3-2.5)	0	0.0 (0.0-56.1)	8	2.3 (1.2-4.5)
13	1	0.3 (0.0-1.6)	0	0.0 (0.0-1.1)	1	0.3 (0.0-1.6)	0	0.0 (0.0-1.1)	2	0.6 (0.2-2.1)
14	0	0.0 (0.0-1.1)	0	0.0 (0.0-1.1)	1	0.3 (0.0-1.6)	0	0.0 (0.0-1.1)	1	0.3 (0.0-1.6)
Total	104	30.0 (25.4-35.0)	120	34.6 (29.8-39.7)	120	34.6 (29.8-39.7)	3	0.9 (0.3-2.5)	347	

In children aged less than 4 years only untreated teeth were extracted due to caries sequelae or trauma. In C-group the number of extractions of treated and untreated primary teeth in children increased from the age of 4 to the maximum number in the age of 7-9 years and then decreased to the minimum number in the age of 10-14 years.

In O-group the extractions of primary teeth started from the age of 5 and increased to the maximum number in 7-year-olds, then decreased to the minimum number in the age of 12-14 years. Dental trauma was the reason for primary tooth extraction only in the children aged 2-4 years.

The proportions of primary tooth extractions in the age of 1-4 and 11-14 years were the lowest (from 0.3% to 3.7%), then increased from 11.2% (95% CI 8.3-15.0%) in 5-year-olds to 19.6% (95% CI 15.8-24.1%) in 7-year-olds and decreased from 16.4% (95% CI 12.9-20.7%) in 8-year-olds to 10.1% (95% CI 7.3-13.7%) in 10-year-olds. The majority of all extractions were performed in the children aged 6-9 years.

In the children under 11 years the number of extracted primary teeth in C-group was more than in O-group. However, in the children aged 11-14 years these differences were not obvious (fig. 1).

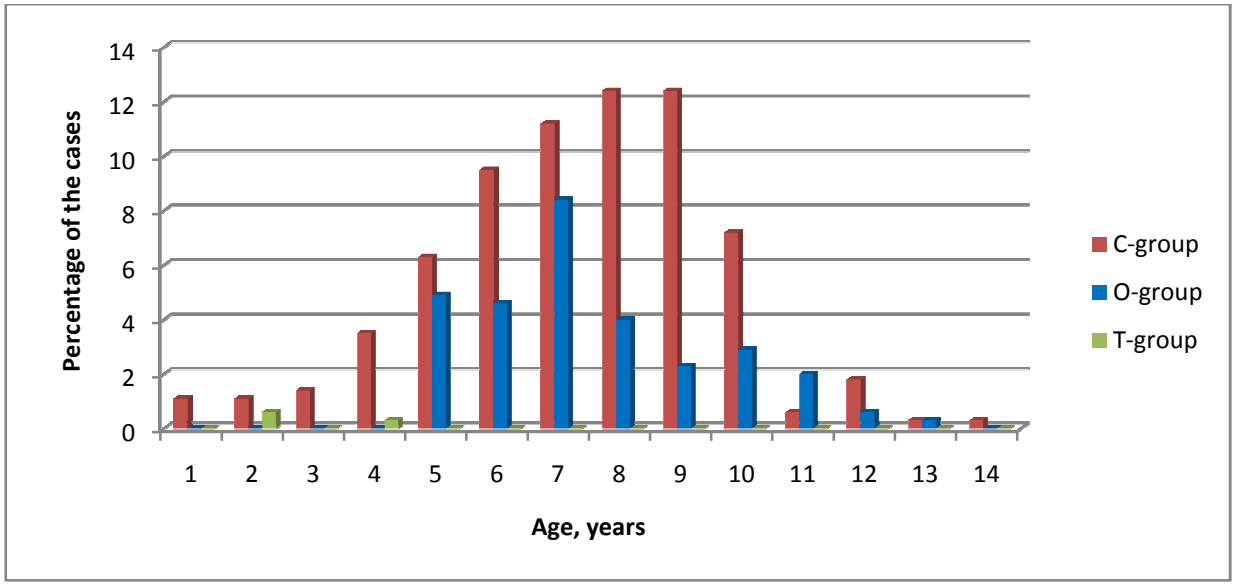

Figure 1. Age distribution of primary teeth extractions in O-, C- and T-groups

The distribution of the extracted primary teeth according to the type of teeth was the following (table 4).

Table 4. The types of the extracted primary teeth in the children

Types of primary teeth	Number and percentage of the cases						Differences between O and C groups	
	O-group		C-group		Total in O-, C- and T-groups			
	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	x^2	p-value
Incisor	64	61.5** (51.9-70.3)	17	7.1** (4.5-11.0)	83	23.9 (19.7-28.7)	118.931	<0.0001
upper	30	28.8** (21.0-38.2)	17	7.1** (4.5-11.0)	49	14.1 (10.8-18.2)	28.885	<0.0001
lower	34	32.7** (24.4-42.2)	0	0.0** (0.0-1.6)	34	9.8 (7.1-13.4)	86.837	<0.0001
Canine	18	17.3** (11.2-25.7)	13	5.4** (3.2-9.0)	32	9.2 (6.6-12.7)	12.512	0.0004
upper	10	9.6* (5.3-16.8)	9	3.7* (2.0-7.0)	20	5.8 (3.8-8.7)	4.859	0.0275
lower	8	7.7* (3.9-14.4)	4	1.7* (0.6-4.2)	12	3.5 (2.0-5.9)	7.682	0.0056
First molar	13	12.5** (7.4-20.2)	123	51.2** (45.0-57.5)	136	39.2 (34.2-44.4)	45.341	<0.0001
upper	7	6.7** (3.3-13.3)	58	24.2** (19.2-30.0)	65	18.7 (15.0-23.2)	14.449	0.0001
lower	6	5.8** (2.7-12.0)	65	27.1** (21.8-33.0)	71	20.5 (16.5-25.0)	20.024	<0.0001
Second molar	9	8.6** (4.6-15.6)	87	36.2** (30.4-42.5)	96	27.7 (23.2-32.6)	27.423	<0.0001

	upper	5	4,8** (2.1-10.8)	44	18.3** (13.9-23.7)	49	14.1 (10.8-18.2)	10.810	0.0010
	lower	4	3,8** (1.5-9.5)	43	17.9** (13.6-23.3)	47	13.5 (10.3-17.5)	12.213	0.0005
Total	upper	52	50.0 (40.6-59.4)	128	53.3 (47.0-59.5)	183	52.7 (47.5-57.9)	0.316	0.5741
	lower	52	50.0 (40.6-59.4)	112	46.7 (40.5-53.0)	164	47.3 (42.1-52.5)	0.316	0.5741
Upper and lower		104		240		347			

* the differences between O- and C-groups are statistically significant, $p<0.05$, ** $p\leq0.001$

In T-group only upper primary teeth were extracted (two incisors and one canine). In O-group the majority of the extracted teeth were incisors – 61.5% (95% CI 51.9-70.3%), a little more on the lower jaw than on the upper jaw; the percentage of the other extracted teeth were lower: canine – 17.3% (95% CI 11.2-25.7%), first molars – 12.5% (95% CI 7.4-20.2%), second molars – 8.6% (95% CI 4.6-15.6%); the numbers of the extracted upper canines and molars were slightly higher than the lower ones.

In C-group most of the extracted teeth were the molars (87.4%, CI 82.7-91.1%), the first molars – 51.3% (95% CI %) cases, followed by the second molars – 36.2% (95% CI %) cases; the incisors and canines were extracted rarer: 7.1% (95% CI %) and 5.4% (95% CI %) cases respectively; the number of the extracted upper teeth were a little higher than the number of the extracted lower teeth. The differences between the distributions of the extracted primary teeth types in O- and C- groups were significant statistically.

In total the first molars were the most frequently extracted primary teeth (39.2%, 95% CI 34.2-44.4%), followed by the second molars (27.7%, 95% CI 23.2-32.6%) and the incisors (23.9%, 95% CI 19.7-28.7%).

The distribution of the extracted primary teeth according to the number of the affected surfaces was studied in C-group on 227 teeth (table 5).

Table 5. The distribution of the extracted primary teeth according to the number of the affected surfaces in C-group

Types of teeth	Number and percentage of cases with carious lesions according to affected surfaces:						
	1 surface		2 surfaces		> 2 surfaces		total
	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n
Incisors and canines	9	30.0 (16.7-47.9)	1	3.3 (0.6-16.7)	15	50.0 (33.1-66.8)	25
First and second molars	13	6.4 (3.8-10.7)	122	60.4 (53.5-66.9)	67	33.2 (27.0-39.9)	202
All teeth	22	9.7 (6.5-14.2)	123	54.2 (47.7-60.5)	82	36.1 (30.1-42.5)	227

In incisors and canines carious lesions affected one surface in 30.0% (95% CI 16.7-47.9%) cases, two surfaces in 3.3% (95% CI 0.6-16.7%) cases and more than 2 surfaces in 50.0% (95% CI 33.1-66.8%) cases. In molars one surface was affected in 6.4% (95% CI 3.8-10.7%) cases, two surfaces – in 60.4% (95% CI 53.5-66.9%) cases, more than 2 surfaces – in 33.3% (95% CI 27.0-39.9%) cases. Thereby, the extracted carious primary teeth usually had 2 or more affected surfaces, including 15.9% (95% CI 11.7-21.2%) teeth with completely destroyed crowns.

In C-group chronic apical periodontitis without any patients complaints (pain, swallowing, etc.) and clinical signs of acute inflammation (pain at percussion, gum redness, etc.) was diagnosed in 50.0% (95% CI 44.5-57.1%) cases due to radiographic examination (table 6). The exacerbation of chronic apical periodontitis, which was accompanied with the patients' complaints of pain and swelling, the signs of radiolucency at periapical and furcation areas on x-rays, was diagnosed in 45.0% (95% CI 38.8-51.3%) cases. Acute periostitis was diagnosed rarely, in 2.5% (95% CI 1.1-5.3%) cases, only in previously untreated teeth. Radicular cyst was diagnosed rarely either, in 1.7% (95% CI 0.6-4.2%) cases, only in the teeth which had been previously treated with pulpotomy. The differences in the frequencies of

various diagnoses between treated and untreated teeth were not significant statistically ($p>0.05$).

Table 6. The frequency of caries sequelae diagnosis in relation to the previous treatment in C-group

Diagnosis	Number and percentage of the cases in the teeth which had been previously:				Total	
	treated		untreated			
	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)
Chronic apical periodontitis without patients' complaints and clinical signs of inflammation	53	44.2 (35.6-53.1)	55	45.8 (37.2-54.7)	108	45.0 (38.8-51.3)
Chronic apical periodontitis with patients' complaints and clinical signs of inflammation	63	52.5 (43.6-61.2)	59	49.2 (40.4-58.0)	122	50.8 (44.5-57.1)
Acute periostitis	0	0.0 (0.0-3.1)	6	5.0 (2.3-10.5)	6	2.5 (1.1-5.3)
Radicular cyst	4	3.3 (1.3-8.2)	0	0.0 (0.0-3.1)	4	1.7 (0.6-4.2)
Total	120		120		240	

Therefore, in the primary teeth referred for extraction the main diagnosis was apical periodontitis – in 95.8% (95% CI 92.5-97.7%) cases, another diagnosis rarely occurred (periostitis or radicular cyst).

The analysis of the available 207 (86.2% of 240 cases) radiographs, which had been taken before primary tooth extractions, revealed pathological root resorption in 69.6% (95% CI 63.0-75.4%) of the examined teeth. In all the cases of chronic apical periodontitis and periostitis extensive radiolucency without clear demarcation in the periapical area of the incisors and canines, in the periapical and furcation areas in the molars was revealed. Round or oval radiolucency (more than 1sm) with the well-demarcated outline located at the apex of the tooth was revealed in all the cases of radicular cyst.

The study of 114 cases of tooth extractions after pulpitis treatment revealed the factors, which could provoke apical periodontitis development (table 7). In some cases more than one factor were revealed.

Table 7. The factors which could provoke apical periodontitis development after pulpitis treatment in the primary teeth

Factors	Number and percentage of the cases	
	n	% (95% CI)
Inhomogeneous filling of pulp chamber and root canal orifices with the materials used for pulpotomy or inhomogeneous filling of root canals at pulpectomy	11	9.6 (5.5-16.5)
The whole or partial loss or fracture of restoration followed with the extension of carious destruction of primary tooth hard tissue	50	43.9 (35.1-53.0)
Disturbance of restoration's marginal integrity, secondary caries development due to marginal leakage	62	54.4 (45.2-63.2)
The wrong choice of a treatment method or the breach in the implementation of pulpotomy or pulpectomy	6	5.3 (2.4-11.0)
Total	114	

The failure of the restorations was the main factor which could promote apical periodontitis development after pulpitis treatment – 98.2% (CI 93.8-99.5%) cases. Disturbances of marginal integrity and secondary caries development due to marginal leakage were revealed in 54.4% (95% CI 45.2-63.2%) cases, the whole or partial loss or the fracture of restoration, extension of carious destruction of primary tooth hard tissue were revealed in 43.9% (35.1-53.0%) cases. Disturbances in the filling of pulp chamber or root canal orifices with the materials used for pulpotomy or inhomogeneous filling of root canals at pulpectomy were revealed in 9.6% cases (95% CI 5.5-16.5%). Those 5.3% (95% CI 2.4-11.0%) can be explained by the wrong choice of a treatment method or the breach in the technique of pulpotomy or pulpectomy.

Discussion

The aim of our study was the analysis of the reasons for primary teeth extractions in children. It was revealed that the main reason for primary teeth

extraction in children aged 1-14 years was caries sequelae, which were identified in 69.2% (95% CI 64.1-73.8%) cases. The obtained data correspond to the results of the other researchers, who reported that caries was the reason for primary teeth extraction in 57.0-64.3% cases [1,2,8,18,19]. The differences between our research and the reported frequencies may be explained by different levels in caries prevalence and intensity in studied populations.

In our study dental injury was the rare reason (0.9%, 95% CI 0.2-2.5%) for primary teeth extraction. However, in the other investigations trauma was the cause of primary teeth extraction in the wide range, from 4.0% to 43.0% [1,2,19], which may be connected with the differences in the lifestyle of children, common approaches to treatment modalities of dental trauma in primary teeth in different countries.

Disturbances in permanent tooth eruption as the reasons for primary teeth extraction were revealed in about one third of the cases in our study. Meanwhile, in the other studies these reasons were noticed significantly rarer [18,19], which may be explained by the differences in the levels of orthodontic care and the views on the problem.

In the study of Samuel et al. [9] the majority of primary teeth were extracted in 6-9 years old children. We obtained the similar data: 64.8% (95% CI 59.7-69.7%) extractions of primary teeth were made in the children aged 6-9 years. The extension of age frames by one year (from 5 to 10 years) increased the number of extracted primary teeth to 86.2% (95% CI 82.1-89.4%).

In our study the most often extracted type of teeth in the children was primary molar (66.8%, 95% CI 61.7-71.6%), then – incisor (23.9%, 95% CI 19.7-28.7%) and canine (9.2%, 95% CI 6.6-12.7%). Similar data were presented by the other researchers [1,2,19,20]. The distribution of teeth types extracted due to caries sequelae is in accordance with the data about caries frequency in various types of primary teeth in children [17].

In contrast, we revealed that the disturbances in permanent tooth eruption were the reason to extract primary incisors more often than molars and canines. On the basis of these data we can suppose that the retardation of primary molars occurred less often than of incisors and canines. However, it is possible, that the parents' attention was paid more often to incorrect or

delayed eruption of permanent teeth in an aesthetically significant area of incisors and canines than in less visible area of permanent premolars eruption.

Among primary teeth, which were extracted due to caries sequelae, previously treated and untreated teeth were registered equally; that was in accordance to the study results of Ockell & Bågesund [19]. The majority (90.4%, CI 86.0-93.5%) of extracted carious teeth, independently of previously provided treatment, had caries lesions on 2 or more surfaces. It is known that the impossibility of primary tooth restoration is the indication for its extraction [21]. Probably, this factor played a certain role in the frequency of carious teeth extractions in the studied population. These data highlight the importance of early caries detection and treatment in primary teeth in children.

The exacerbation of chronic periodontitis with severe toothache and swelling was found in every second case of primary teeth extractions. This fact reflects low parents' motivation to regular dental check-ups, caries prevention and timely treatment for their children and, possibly, limited access to dental service. Our data correspond with the results of the other researchers about the parents' insufficient knowledge of dental problems, social-economic inequalities in oral health in children, low parents' compliance with preventive recommendations of dentists [22,23,24].

Radiographic examination, which was performed before primary tooth extraction, revealed pathological root resorption in the majority (69.6%, CI 63.0-75.4%) of the cases. In all the cases of chronic apical periodontitis and periostitis extensive radiolucency in periapical and furcation areas was noticed. The obtained data confirm that radiographic pathological signs in periapical and furcation areas of a primary tooth are the strong argument for the extraction in decision-making process [25].

Many teeth were extracted due to pulpitis treatment failure, which had been mainly (86.8%, CI 79.4-91.9%) caused by low longevity of restorations (restoration loss, fracture, marginal leakage or secondary caries). These data confirmed the importance of restorations quality at caries and pulpitis treatment in primary teeth in children [19].

Conclusions

The main reason for primary teeth extraction in children aged 1-14 years was caries sequelae (69.2%) followed by disturbances in permanent

teeth eruption (30.0%). The majority of primary teeth were extracted in children aged 6-9 years. The most commonly extracted type of teeth due to caries sequelae were molars, due to disturbances in permanent teeth eruption – incisors. Among the primary teeth, which were extracted due to caries sequelae, previously treated or untreated teeth occurred equally often. Most of them had carious lesions on 2 or more surfaces, pathological root resorption and extended radiolucency in periapical and furcation areas. Restoration loss, fractures, marginal leakage or secondary caries were revealed in 86.8% primary teeth which were extracted after pulpitis treatment failure. Regular dental check-ups, detection and treatment of early caries lesions, improvement of restorations' quality are necessary for the prevention of premature primary teeth extraction in children.

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