Research Paper: Periodontal Diseases and Dental Caries in Children With Cerebral Palsy

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ABSTRACT

Objectives: Musculoskeletal disorders in children with Cerebral Palsy (CP) affect the general health of the mouth and teeth. This study aimed to determine periodontal and dental diseases in children with CP based on gross motor function level, manual ability level, and subtypes of CP.

Methods: This research was a cross-sectional study performed on 123 children (3-18 years old) with CP referred to dentistry and rehabilitation centers supervised by Tehran University of Medical Sciences in 2019-2020. They were selected by the convenience sampling method. The children were classified according to the gross motor function classification system: expanded and revised (GMFCS-E&R) for their gross motor function level, according to the manual ability function classification system (MACS) and mini-MACS for the functioning of their hands in handling objects, and according to the quality and topographical pattern of motor impairment for subtypes of CP. The periodontal status of children with CP was evaluated according to the recommendation of the World Health Organization using the community periodontal index and for caries according to the decayed, missing, filled index. All statistical analyses were done by SPSS v. 16.

Results: The results showed significant differences between periodontal disease and sex, age, GMFCS-E&R, MACS, mini-MACS levels, and subtypes of CP ($P<0.05$). But there were no significant differences between teeth diseases and oral motor skills with sex, age, MACS and mini-MACS, GMFCS-E&R levels, and subtypes of CP ($P>0.05$).

Discussion: Periodontal disease and decayed, missing, filled teeth are common problems in CP children, and the conditions worsen with age and level IV and V of GMFCS-E&R and MACS.

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Highlights

- In the present study, 68 children (55.3%) with CP suffered from periodontitis.
- A significant relationship was found between periodontal disease and the subtype of CP.
- Periodontal diseases were higher in children aged 10-15 years and in levels IV, V GMFCS-E&R in children with CP.

Plain Language Summary

Children with Cerebral Palsy (CP) are more at risk of poor oral health, that is negatively affects their quality of life. This matter may be due to the low ability to maintain hygiene, which, in turn, may make it difficult for CP children to feed. In this study, the community periodontal index and the decayed, missing, filled index were used to determine periodontal and dental diseases in children with CP, based on gross motor function level, manual ability level, and subtypes of CP. In our study, 123 CP children were selected by the convenience sampling method. The results showed periodontal disease and decayed, missing, filled teeth are common problems in CP children, and these situations get worse with age and level IV and V of GMFCS-E&R (gross motor function classification system: expanded and revised) and MACS (manual ability function classification system).

1. Introduction

Children with Cerebral Palsy (CP) usually have poor oral health due to neuromuscular problems [1]. More than 90% of CP children have motor-oral problems [2]. Neuromuscular problems in these children can cause changes in the structure of the mouth, gingiva, and teeth. These conditions cause nutritional problems, dental maintenance and hygiene status, and difficulty using dental care products [3]. Because of lack of motor coordination and reduction of their collaboration in effective oral care, children with CP are more at risk of tooth decay, which negatively affects their quality of life [4, 5]. Studies have shown that gingival and periodontal diseases are more common in children with CP. This effect may be due to the low ability to maintain hygiene and the formation of biofilms [6]. Another critical issue is the use of anticonvulsant medicines, especially phenytoin [7]. Jan et al. (2016), in a review study of the oral health of children with CP, reported that gingivitis and bleeding gums occur more frequently in children with CP.

Difficulty in maintaining daily oral hygiene, intraoral hypersensitivity, and oral-facial dysfunction are the main causes of periodontal problems in these patients. Gingival hyperplasia is a predictor of periodontal disease and occurs more in children with spastic quadriplegia, especially in older ages [8]. Dos Santos et al. reported a higher prevalence of tooth decay in children with CP than in other diseases [9]. In another study, oral health-related quality of life decreased with increasing gross motor function, which seems to highlight the role of gross motor function in oral health in children with CP [10].

Lack of access to dental care leads to caries remaining untreated in these children and causing more problems. Mouth breathing, more oral infections, and food retention in the oral cavity (especially in the interdental space) can cause more caries in children with CP [11].

The oral health problems, in turn, may make it difficult for CP children to feed. On the other hand, the development of children with CP usually is slower than other children, and nutritional problems reduce the storage of fat and energy sources in these children and slow down the children's growth [12]. Considering the critical role of oral health management in feeding a child with CP and its effect on nutritional care, nutritional health, and decreasing oral health risk behaviors, this study aimed to determine periodontal and dental diseases in children with CP based on gross motor function, manual ability levels, and subtypes of CP.

2. Materials and Methods

Study participants

In this cross-sectional study, the statistical population consisted of all children with CP aged 3-18 years referred to dentistry and rehabilitation centers supervised by the Tehran University of Medical Sciences (TUMS) in 2019-2020.

The sample size was estimated as 111 people taking into account the effect size of 0.3, the type I error of 0.05, and the test power of 0.8 according to the previous research and the researcher's expectations. Because of the probability of dropout, the sample size was considered 125. Finally, 123 CP children were selected by the convenience sampling method. Children who met the following inclusion criteria were included in the study: children with CP aged 3-18 diagnosed by a pediatric neurologist and free of vision and hearing problems, abnormalities of the oral structure, including cleft lip and palate; not under systemic antibiotics use in the last 3 months; and not received professional periodontal treatment in the last 3 months or dental services in the last 6 months. Children were excluded if they or their parents were not willing to participate in each study stage. This study protocol was approved by the Ethics Committee of TUMS (Code: IR.TUMS.FNM.REC.1398.196).

Study procedure

The researcher reviewed a list of daily outpatient clinic appointments in terms of inclusion criteria. If a patient met the inclusion criteria, the child and her/his parents were informed of the study's objectives, and if they agreed to participate, their written and signed informed consents were obtained. Then, their demographic and clinical information was completed by an occupational therapist. This information includes age, gross motor function level using gross motor function classification system expanded and revised (GMFCS-E&R) [13], manual ability level using manual ability function classification system (MACS) [14], mini-MACS [15]. Also, the subtype of CP was determined according to the quality and topographical pattern of motor impairment [16].

Dental examinations were conducted according to the World Health Organization (WHO) protocol, used flat dental mirrors, a special dental CPI-probe (WHO-probe), and sufficient light on the dental unit by a dentist.

The periodontal status of children with CP was evaluated using the community periodontal index (CPI) [17, 18]. Then, the teeth status was examined for caries according to the Decayed, Missing, Filled (DMF) index [19].

Outcome Measurements

The gross motor function classification system: expanded and revised (GMFCS-E&R) assesses children up to 18 years of age [13]. It classifies gross motor function on a 5-point ordinal scale. The reliability of GMFCS-E&R had been established in Persian for children with CP [20]. In 2006, the manual ability classification system (MACS) was designed to describe hand performance in activities of daily living for children with CP. Its validity and reliability had been established in Persian [21].

To achieve CPI, the surfaces of all erupted teeth were examined for gingival bleeding and gingival pocket and scored as follows: (0) health periodontal conditions; (1) gingival bleeding on probing; (2) calculus and bleeding; (3) periodontal pocket depth of 4-5 mm; and (4) periodontal pocket ≥6 mm [17, 18]. DMF index that was applied to the permanent and milk teeth using a CPI (WHO) probe, which considers fillings (F) and decayed (D) and missing (M) teeth in an individual [19].

Statistical analysis

Due to the number of samples in the present study, levels I, II, IV, and V of classification systems (GMFCS-E&R, MACS, Mini MACS) were combined. The Chi-square test was used to analyze the intergroup difference based on motor function, manual ability levels. All statistical analyses were done at a significance level <0.05, using SPSS v. 16.

3. Results

The sample of this study consisted of 123 children with CP. Table 1 presents the characteristics of the study population. As was illustrated, of the 123 participants, 75 (61%) were girls, and 48 were boys. Their Mean±SD age was 9.56 (4.38) years. The highest frequency in periodontal disease was in CPI code 2: calculus and bleeding and the lowest in code 4: periodontal pocket ≥6 mm. In this study, 88 children (71.54%) with CP had at least one missing tooth and 97 (78.86%) at least one tooth filling.

Results showed that periodontitis was significantly different among children of different ages (χ^2=31.165, P=0.001) and was more common among the 10-15 years old group (45.6%) than other age groups. Comparing the periodontitis of CP children with different levels of gross motor function showed that the differences were statistically significant (χ^2=6.268, P=0.024) and more common among level IV and V GMFCS-E&R (51.5%) than other levels of GMFCS-E&R. Periodontitis was also more common among children with CP in level IV and V MACS (39.7%) (χ^2=6.913, P=0.032). At mini-MACS levels, children with CP did not have periodontitis and were all in health periodontal conditions code. Besides, there was a significant relationship between periodontitis and the type of CP (χ^2=33.42, P=0.001). The periodontitis in spastic quadriplegia (36.8%) was higher than other

Table 1. Clinical characteristics in children with CP (n=123)

Clinical Characteristics		No.(%)
Age groups (y)	<5	23(18.7)
	5-10	43(35)
	10-15	44(35.8)
	>15	13(10.6)
Type of CP	Spastic hemiplegia	37(30.1)
	Spastic diplegia	24(19.5)
	Spastic quadriplegia	29(23.6)
	Ataxic	9(7.3)
	Dyskinetic	11(8.9)
	Chorea athetosis	10(8.1)
	Hypotonic	3(2.4)
GMFCS-E&R	I, II	52(42.3)
	III	16(13)
	IV, V	55(44.7)
MACS	I, II	37(35.2)
	III	33(21.4)
	IV, V	35(33.3)
Mini-MACS	I, II	5(27.8)
	III	3(16.7)
	IV, V	10(55.6)

Periodontal disease codes		
CPI		**No.(%)**
0- Health periodontal conditions		55(44.7)
1- Gingival bleeding on probing		1(0.8)
2- Calculus and bleeding		64(52)
3- Periodontal pocket depth of 4–5mm		2(1.6)
4- Periodontal pocket ≥ 6 mm		1(0.8)
DMFT index		n(%)
Filling	0	26(21.1)
	≥ 1	97(78.9)
Decay	0	23(18.7)
	≥ 1	100(81.3)
Missing	0	35(28.5)
	≥ 1	88(71.5)

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CP: Cerebral Palsy; CPI: Community Periodontal Index; GMFCS-E&R: Gross Motor Function Classification System: Expanded and Revised; MACS: Manual Ability Function Classification System; DMFT: Decayed, Missing, Filled Teeth.

Table 2. CPI among children according to age groups, GMFCS-E&R, MACS, subtype of CP

Variables		No.(%) Periodontitis		χ^2	df	P
		Healthy	Unhealthy			
Age groups (y)	<5	22(40)	1(1.5)	31.165	3	0.0001
	5-10	17(30.9)	26(38.2)			
	10-15	13(23.6)	31(45.6)			
	>15	3(5.5)	10(14.7)			
GMFCS-E&R	I, II	30(54.5)	22(32.4)	6.268	2	0.044
	III	5(9.1)	11(16.2)			
	IV, V	20(36.4)	35(51.5)			
MACS	I, II	19(34.5)	18(26.5)	6.913	2	0.032
	III	10(18.2)	23(33.8)			
	IV, V	8(14.5)	27(39.7)			
Type of CP	Spastic	43(78.3)	47(69.1)	33.42	6	0.001
	Ataxic	3(5.5)	6(8.8)			
	Dyskinetic	8(14.5)	3(4.4)			
	Chorea	0	10(14.7)			
	Hypotonic	1(1.8)	2(2.9)			

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CP: Cerebral Palsy; GMFCS-E&R: Gross Motor Function Classification System: Expanded and Revised; MACS: Manual Ability Function Classification System.

types of CP (Table 2). No statistically significant differences were found between the DMF index of CP children in terms of different age groups, gross motor level, manual ability level, and subtype of CP (Table 3).

4. Discussion

This study was conducted to identify associations between gross motor function, manual ability levels, and subtypes of CP and periodontal and dental diseases in children with CP. In the present study, 68 children (55.3%) with CP suffered from periodontitis. The results in this study were similar to those reported elsewhere [6, 22-24]. Another study examined plaque status and gingival health in 140 children with CP in Riyadh, with mild to moderate plaque accumulation and gingivitis increased as the age of the children increase [22]. Guare and Ciampioni reported that periodontal diseases such as gingivitis and plaque were more common in children with CP than in healthy children [24].

Among the main findings, a significant relationship was found between periodontal disease and subtype of CP. Periodontal disease was more prevalent in children with spastic quadriplegia. The results of this study were consistent with Jan's study that showed gingival hyperplasia and bleeding occur more frequently in children with CP, and periodontal disease occurs in spastic quadriplegia children, especially in older ages [8]. A possible explanation for this result may be that children with severe CP have difficulty in access to dental services and have great challenges for oral hygiene [25], particularly if the children with severe CP have pathological primitive oral reflexes such as gagging, biting, rooting, and suckle-swallow reflexes [9].

The periodontal disease appeared to be significantly higher in gross motor function level, and periodontal diseases were higher in levels IV and V of GMFCS in children with CP. Sedky reviewed the oral health status of Egyptian children with CP in terms of gross motor levels

Table 3. DMF index among children according to age groups, GMFCS-E&R, MACS, subtype of CP

Variables		χ^2	df	P
Missing	Age groups	1.640	3	0.650
Filling		3.254	3	0.354
Decayed		1.145	3	0.766
Missing	GMFCS: E&R	1.544	2	0.462
Filling		0.922	2	0.631
Decayed		5.535	2	0.063
Missing	MACS	2.486	2	0.289
Filling		3.197	2	0.202
Decayed		4.361	2	0.113
Missing	Subtype of CP	3.793	6	0.705
Filling		7.003	6	0.321
Decayed		0.890	6	0.989

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CP: Cerebral Palsy; GMFCS-E&R: Gross Motor Function Classification System: Expanded and Revised; MACS: Manual Ability Function Classification System; DMF: Decayed, Missing, Filled.

and types of CP and reported that GMFCS is the best predictor variable for gingivitis and children in levels IV and V GMFCS compared to children in levels I, II, and III experience 17 times more severe gingivitis [26]. A possible explanation for this might be the severity of the neurological damage in children with CP, which increases the risk of periodontitis [9, 24]. The children in levels IV and V of GMFCS have more plaque, food debris, and mouth breathing rate, explaining the higher rate of caries [9]. These children need to get efficient oral hygiene, but they have limited access to dental care services.

Furthermore, the periodontal disease appeared to be significantly higher in CP children aged 10-15 years that was similar to that reported by Sedky et al. [26]. Age was as the second predictor variable that older children at levels IV and V had 6.6 times more likely than younger children at levels I, II, III to be more prone to gingivitis, and 57.7% of children with CP aged 7-10 years and older had more severe gingivitis [26].

In the present study, 88 children (71.54%) with CP had at least one missing tooth, 97 (78.86%) at least one filled tooth, and 100 (81.30%) at least one decay tooth, which is in accord with the findings of earlier studies [27-29]. Dos Santos et al. reported that CP children with permanent dentitions have a more mean decayed, missing, and filled surfaces index, also as a more plaque index for both sexes than healthy children [28]. In a study in Brazil, 49.5% of children with CP had at least one tooth with untreated caries, and the prevalence of untreated dental caries was higher than the population of healthy children in the same age range [27]. No association was found between dental disease and subtype of CP, gross motor function, and manual ability levels. It is a consensus in literature [30, 31]. Furthermore, this finding contradicts other studies [26, 32], which suggest that DMF score was influenced by GMFCS, MACS, and subtype of CP. One of the reasons for the lack of agreement may be the type of study. Quritum et al. [32] and Sedky et al. [26] studies were case-control studies with two groups of CP children and a control group, while Cardoso et al. [30] and our study were cross-sectional with only children with CP.

One of the limitations of this study was the convenience sampling method, and only children with CP of dentistry and rehabilitation centers supervised by TUMS were enrolled in the study.

5. Conclusion

The results showed that children with CP often suffered from periodontal disease, especially plaque and bleeding. These diseases were more prevalent in the IV and V GM-

FCS-E&R and age group of 10-15 years. Also, the prevalence of dental problems (missing, filled, the decayed tooth) was high at all levels of GMFCS-E&R, different ages, and types of CP. As these children are at risk for dental caries and periodontal disease, earlier preventive strategies should be incorporated within therapeutic programs for children with CP. Furthermore, it is suggested that a dental care system be developed for these children with disabilities that help to improve the oral health education of parents, caregivers, and nurses, reinforcing childhood prevention programs, and motivating dentists. Also, oral-dental problems and their effect on nutrition in children with CP should be included in the curriculum for Occupational Therapy (OT) students in daily livings.

Ethical Considerations

Compliance with ethical guidelines

The Ethics Committee of Tehran University of Medical Sciences approved this study (Code: IR.TUMS.FNM.REC.1398.196).

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Authors' contributions

Conceptualization: Leila Dehghan, Hamid Dalvand, Hooshang Dadgar; Methodology: Hamid Dalvand, Leila Dehghan, Saman Maroufizadeh, Sarvin Sarmadi; Investigation: Leila Dehghan, Hamid Dalvand; Writing – original draft: Leila Dehghan, Hamid Dalvand ; Writing – review & editing: All authors; Supervision: Leila Dehghan.

Conflict of interest

The authors declared no conflict of interest.

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