Review Article

PREVALENCE OF DENTAL DEFECTS AMONG PEDIATRIC PATIENTS WITH CEREBRAL PALSY: A SYSTEMATIC REVIEW

Nancy Ajwa[1], Zahra Ahmed Ali Alhuwayji[2], Hanan Mohammed Masiri[3], Nidaa Mohammad Alhaddad[3], Lamees Tawfik Allaf[3], Abdulhakim Muteb Raja AlMutairi[4], Nourah Mohammed Al-Lwemi[5]*

[1]*Department of Preventive Dentistry, Faculty of Dentistry, Riyadh Elm University, Saudi Arabia. nancy.ajwa@riyadh.edu.sa*
[2]*Armed Forces Hospital, Ministry of Defense, Southern Region (AFSHAR), Khamis Mushait, Saudi Arabia.*
[3]*Al-Naeem P.H.C., King Fahad Hospital, Ministry of Health, Jeddah, Saudi Arabia.*
[4]*Department of Dentistry, King Saud Dental University Hospital, Riyadh, Saudi Arabia.*
[5]*Department of Dentistry, College of Dentistry, Riyadh Elm University, Saudi Arabia.*

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ABSTRACT

Children with CP are at a higher risk of poor dental health and systemic health implications due to their impairment. Past and present caries experience, nutrition, fluoride exposure, presence of cariogenic bacteria, salivary state, and sociodemographic variables are all factors in the development of caries. Oral drugs with xerostomia potential used over an extended time, promotor dysfunction, and a lack of regular oral hygiene are additional risk factors. A systematic literature review from 2009 to 2022 was performed using PubMed, Medline, and ScienceDirect databases. The keywords used were "dental defects," "cerebral palsy," "pediatric patients," "systematic review." PRISMA flowchart was used to describe the selection process of searched articles. A total of nine studies were included in this review, with six of them stating no significant change in the color, opacity, and fluorescence of composite restorations. The majority of the studies revealed that dental defects such as caries, periodontal disease, and erosion are commonly found among pediatric patients having cerebral palsy.

Key words: Hydrogen peroxide, Composite resins, Bleaching, Systematic review.

Introduction

Cerebral palsy (CP) is a persistent neurodevelopmental disorder caused by brain damage in infancy. Children with CP are at a higher risk of poor dental health and systemic health implications due to their impairment [1-3]. CP is divided into quadriplegia, diplegia, and hemiplegia, each of which refers to a different kind of motor impairment. Spastic, dyskinetic, ataxic, and mixed kinds are distinguished based on the severity of neurological impairment. As a result, the patient will continue to struggle with self-care and dental health maintenance issues throughout their lives. Past and present caries experience, nutrition, fluoride exposure, presence of cariogenic bacteria, salivary state, and sociodemographic variables are all factors in the development of caries. Oral drugs with xerostomia potential used over an extended time, promotor dysfunction, and a lack of regular oral hygiene are additional risk factors [4].

Caries is a significant problem for children with CP, and previous research has shown that their oral health is typically worse than those without CP. This results in more extractions, lower-quality decaying teeth restorations, and worse oral hygiene. Neuromuscular disorders, structural changes in the orofacial area, feeding issues, challenges maintaining oral hygiene, and lack of access to dental care may all contribute to this rising rate of caries. Because caretakers monitored oral hygiene in 73.1% of cases owing to poor manual dexterity, De Carvalho *et al*. [5] found no significant connection between CP type and the frequency with which one brushes one's teeth. These findings support research by Camargo and Antunes. The risk of oral illness increases with the degree of neurological injury, as shown by the fact that the mean decayed-missing-filled (DMF) score of people with quadriplegia was twice that of the hemiplegic group (2). A focused study into increasing oral health is necessary due to declining access to dental care and the capacity to practice good oral hygiene. The degree of dental caries, the child's communication ability, and the family's socioeconomic status affect the child's oral health-related quality of life [6]. Although a greater caries incidence has been seen in the group, few studies have accounted for the complete range of risk variables that potentially impact subpopulations of CP patients. Socioeconomic position, CP subtype, demographics, oral cavity health, dental hygiene practices, and food and nutrition were all identified as potential risk factors [7].

Providing effective oral health education to children and adolescents with CP requires first understanding the variables contributing to this population's high decay rate. To better understand the key risk factors contributing to this susceptible group's high prevalence of dental caries, the current study attempted to summarize primary data. Several studies are used to design this future systematic review by assessing the extent and depth of the current evidence and pointing out any knowledge gaps that may exist. This study

synthesizes previously identified risk variables into distinct areas from which more research can be conducted [8].

Materials and Methods

A systematic literature review from 2012 to 2022 was performed using PubMed, Medline, and ScienceDirect databases. The keywords used were "dental defects," "cerebral palsy," "pediatric patients," "systematic review" **(Table 1)**. PRISMA flowchart was used to describe the selection process of searched articles **(Figure 1)**.

Table 1. Inclusion and exclusion criteria

№	Inclusion criteria	Exclusion criteria
1.	Case-control and randomized control studies	Systematic reviews or meta-analyses or expert opinions, or narrative reviews
2.	Published between 2009 and 2022	Out of the specified time range
4.	English language of publication	Language other than English
7.	In vivo (humans)	In vitro

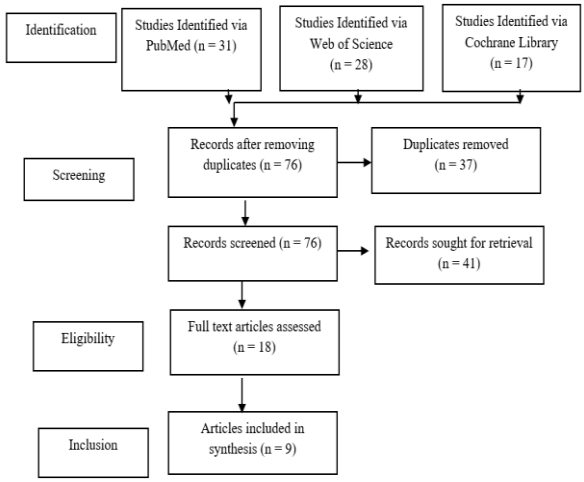

Figure 1. PRISMA Flow Diagram

Risk of bias assessment

Cochrane risk of bias assessment method was used to assess the quality of the studies included **(Table 2)**.

Table 2. Summary of Cochrane Risk of Bias Assessment

Study	Selection Bias/Appropriate control selection/baseline characteristics similarity	Selection bias in randomization	Selection bias in allocation concealment	Performance-related bias in blinding	Reporting bias/Selective reporting of outcomes	Detection bias Blinding outcome assessors	Accounting for confounding bias
Du RY *et al*., (2010) [9]	+	+	+	+	+	+	-
Cardoso *et al*., (2015) [10]	+	+	+	+	-	+	-
Gržić *et al*, (2011) [11]	+	+	+	+	+	_	+
POLAT *et al*., (2013) [12]	+	+	+	+	+	+	-
Santos *et al*., (2009) [6]	+	-	+	+	+	+	+
Lin *et al*., (2011) [13]	+	+	+	-	+	+	+
Al Hashmi *et al*., (2017) [14]	+	+	+	+	+	+	-
Santos *et al*., (2017) [15]	+	-	+	+	+	+	+
Dias *et al*., (2016) [16]	+	+	-	+	+	+	+

Results and Discussion

The study by Du RY *et al*. (2010) [9] aimed to evaluate the oral health of preschoolers with and without cerebral palsy (CP). Seventy-two preschoolers aged (±3 months) with cerebral palsy (CP) were selected. For every 100 children with CP, 42.5 had dental caries (dmfs>0), and the fs averaged 0.45. Preschoolers with and without CP had similar rates of dental caries (P > 0.05). For the index teeth, the average plaque index score of children with CP was

0.89, whereas the average gingival index score was 0.81. When comparing children with and without CP, those with CP scored higher on both the plaque index (P <0.001) and the gingival index (P = 0.02). Gingival hyperplasia was seen in 19.2% (14/72) of CP-affected children. Contrarily, children without CP did not exhibit any signs of gingival hyperplasia.

The research by Cardoso *et al*. (2015) [10] aimed to examine the rates of dental caries and periodontal disease in Brazilian teens and children with cerebral palsy and the risk factors related to (CP). Eighty patients between the ages of two and eighteen participated in this cross-sectional research. The mean GBI was 22.44%, and in the CPI, the prevalence of gingival bleeding, calculus, shallow and deep pockets were 94.73%, 79.62%, 12.90%, and 3.22%, respectively. Caregivers with fewer than eight years of schooling were more likely to have had dental caries. Negative associations were found between periodontal changes and being female, having a caregiver with less than eight years of education, poor oral perception, serious communication problems, and an athetoid type of CP. High rates of dental caries and periodontal changes were found in CP patients, and these findings were linked to the patients' epidemiological, social, economic, dental health perception, and systemic data.

Gržić *et al*. (2011) [11] in their study compared the dental and oral health of children with and without cerebral palsy (CP). Fifty youngsters with CP were recruited from organizations that serve children with disabilities. Eventually, after selecting 43 kids, the research was done. Seven- to sixteen-year-olds were clinically examined. There is a statistically significant difference between the number of filled teeth in typically developing children and those of children with CP. Youngsters with CP are more likely to have extractions than other children. One of the components of the DMFT index is the number of teeth with decay, and there is no statistically significant difference between the two groups. This indicates that not all children in either group received enough curative therapy since decayed components were more prevalent than extractions and fillings. It's concluded that if we want to reduce the prevalence of cavities and boost oral health in this at-risk group, we need to start earlier and better organize preventive pediatric and dental care.

The purpose of the study by POLAT *et al*. (2013) [12] was to examine the association between dental erosion (DE) and gastroesophageal reflux disease (GERD) in people with cerebral palsy who had undergone the detection of GERD (CP). A total of 37 kids (19 boys, 18 girls; average age, 12.1. and 2.8 years) with CP were included in the research; 21 of them had dental erosion, while the other 16 did not. It was shown that multi-surfaced DE had a significantly different distribution of interference ratios than non-multi-surfaced DE (P <0.001). Multi-surface erosion was found to be 58.9% or less on 93.6% of the impacted teeth, with the percentage being much lower on the 50% of teeth that had damage to just one or two surfaces. Based on how much tissue was lost during erosion, patients with DE were further categorized as dentin-positive(dentin+) or dentin-negative (dentin-). Comparisons of interference levels based on tissue loss are shown. Interference ratios for dentin+ samples were distributed differently than dentin-samples (P = 0.025).

Santos *et al*. (2009) [6] evaluated the relationship between dental erosion and gastroesophageal reflux in patients with cerebral palsy. One hundred eight people (4 females and 58 males) with CP (ages 4-19) were involved in the research to examine the relationship between caries experience and promotor impairment and dietary consistency. Total DMF mean values (SD) are summarized; D, M, and F teeth are compared to the four categories of OFMFAS in CP patients, and each category is analyzed independently. The four categories of the OFMFAS were not significantly different from one another when comparing the overall DMF index or the individual D, M, and F values (p > 0.311, 0.097, 0.292, and 0.090, respectively). Subjects with severe and moderate impairment had higher total DMF than those with minor and very slight impairment. However, this difference was not statistically significant (p = 0.063).

This analysis by Lin *et al*. (2011) [13] examined the incidence and distribution of developmental enamel abnormalities in CP children in Beijing, China. One hundred thirty-five children were enrolled, ranging in age from 18 months to six years, all of whom had been diagnosed with moderate to severe congenital CP. Forty-four (32.6%) of the 135 CP children had some enamel abnormality (opacity and hypoplasia). Of the CP children examined, 35 (24.9%) were found to have enamel hypoplasia, 5 (3.7%) were found to have opacity alone, and 4 (3.0%) were found to have combined abnormalities. The primary incisors and first molars were the most common sites of enamel abnormalities. Premature birth was a risk factor for enamel abnormalities in 42.4% of children (P<0.05).

The research conducted by Al Hashmi *et al*. (2017) [14] set out to evaluate the state of oral health in CP children in Dubai, UAE (UAE). Eighty-four children with CP and 125 healthy children, ages 4-18, were chosen from Dubai's special needs institutions and private/public schools. Overall, mean DMFT and dmft scores were similar across the two groups. Children with CP had a considerably increased risk of CI. Anterior open bite, anterior spacing, Class II molar Angle malocclusion, trauma, high arched palate, tongue push, lymphadenopathy, angular cheilitis, macroglossia, drooling, and erosion were substantially more common in CP patients than in controls.

Santos *et al*. (2017) [15] investigated how salivary osmolality may affect gingivitis in children with cerebral palsy (CP). This cross-sectional research included 82

children with spastic CP, aged 6-14 years old. Gingivitis was significantly correlated with salivary osmolality, salivary flow rate, clinical plaque index, dental calculus, and clinical plaque index ($r > 0.7$). The predictive value of salivary osmolality for gingivitis incidence was 0.88 ($P<0.001$). The sensitivity and specificity of the 84.5 thresholds for salivary osmolality were more than 77%. The osmolality of saliva greater than 84.5 was associated with a fivefold increase in the risk of gingivitis. In contrast, an increase of 0.1 mL in salivary flow was associated with a 97% decrease in that risk.

Dias *et al*. (2016) [16] analyzed the research done on sialorrhea in kids who have CP. Speech therapy focuses on increasing the patient's sensory awareness and oral motor abilities and is the most effective treatment for sialorrhea in children with cerebral palsy. In situations of moderate to severe sialorrhea or respiratory issues, treatment with botulinum toxin injection and anticholinergics should be explored as an adjuvant to speech therapy due to their temporary effects. In addition to its low price and seemingly excellent clinical response and safety profile, atropine sulfate is also widely available. Trihexyphenidyl may be used to treat sialorrhea in cases with dyskinetic cerebral palsy or other special circumstances.

Table 3. Summary of findings from the included studies

Author's name	Patients	Age	Objective	Dental defects	Results
Du RY *et al*., (2010) [9]	72	±3 months	This study aimed to evaluate the oral health of preschoolers with and without cerebral palsy (CP).	dental caries, Gingival hyperplasia	When comparing children with and without CP, those with CP scored higher on both the plaque index ($P <0.001$) and the gingival index ($P = 0.02$).
Cardoso *et al*., (2015) [10]	80	2 to 18years	This research aimed to examine the rates of dental caries and periodontal disease in Brazilian teens and children with cerebral palsy	Dental caries and periodontal changes	High rates of dental caries and periodontal changes were found in CP patients
Gržić *et al*., (2011) [11]	50	7 to 16	This research aimed to compare the dental and oral health of children with and without cerebral palsy (CP)	Tooth decay	One of the components of the DMFT index is the number of teeth with decay, and there is no statistically significant difference between the two groups
POLAT *et al*., (2013) [12]	37	2 to 12 years	The purpose of this study was to examine the association between dental erosion (DE) and gastroesophageal reflux disease (GERD) in people with cerebral palsy	Dental erosion	Multi-surface erosion was found to be 58.9% or less on 93.6% of the impacted teeth
Santos *et al*., (2009) [6]	108	2 to 19 years	To evaluate the relationship between dental erosion and gastroesophageal reflux in patients with cerebral palsy	Dental erosion, dental caries	The difference was not statistically significant ($p = 0.063$).
Lin *et al*., (2011) [13]	135	18 months to six years	This study aimed to examine the incidence and distribution of developmental enamel abnormalities in CP children	Opacity and hypoplasia	Forty-four (32.6%) of the 135 CP children had some enamel abnormality

Al Hashmi *et al*., (2017) [14]	84	4 to 18 years	This research set out to evaluate the state of oral health in CP children in Dubai	Anterior open bite, anterior spacing, Class II molar Angle malocclusion, trauma, high arched palate	Children with CP had a considerably increased risk of CI
Santos *et al*., (2017) [15]	82	6 to 14	Investigate how salivary osmolality may affect gingivitis in children with cerebral palsy (CP).	Gingivitis	The predictive value of salivary osmolality for gingivitis incidence was 0.88 (P<0.001).
Dias *et al*., (2016) [16]			To analyze the research done on sialorrhea in kids who have CP	Sialorrhea	Speech therapy focuses on increasing the patient's sensory awareness and oral motor abilities

Children with CP were like their peers without CP regarding dental caries but less effective with periodontal status, the two important indices of oral health. There is a lack of consensus on whether children with CP are more or less likely to develop cavities. However, several studies have shown that CP children had the same or a reduced risk of caries. Compared to children from typically developing preschools, those with CP have significantly poorer gingival health. That fits nicely with what has been found in other studies [17]. Children's lack of neuromuscular control may contribute to this problem by making it difficult for them to practice appropriate dental hygiene (especially for older children). The use of anticonvulsive drugs, which are known to produce gingival hyperplasia, may further contribute to the higher incidence of gingival hyperplasia in the CP population [18].

The prevalence of dental caries was higher than that seen in studies involving children with no neurological deficit. Involuntary movements, pathological oral reflection, spasticity of masticatory muscles, and food waste are all thought to play a role in the increased prevalence of dental caries in people with CP [19].

Children with CP have a median DMFT index score of 18.5, whereas those without CP have a median value of 16, and both sets of kids had a DFT index value of 0 (the median value). Both cohorts of kids had similar rates of tooth decay. De Camargo *et al*. [17] found a reduced caries prevalence in the Cp population compared to the normal kid demographic. In contrast, Al-Mendalawi showed an equal frequency, Guaré and Santos indicated a greater prevalence. Since we found no significant difference in tooth decay rates between the two groups, we concluded that children in institutes must get better care than similarly healthy children who live with their parents [20].

Teeth erosion in children with CP has been linked to issues with eating, such as choking, vomiting, chest infections, and irritability. Infection with DE may harm either baby teeth or adult teeth. Possible early symptoms of gastroesophageal reflux disease include enamel erosion affecting the back teeth. In a prospective investigation of GERD and DE in children with primary and permanent dentition, Grzić *et al*. discovered that erosion patterns were more common in the posterior teeth [21].

The significant decay component we observed in this sample is consistent with findings from earlier studies. Our DMF of 5.56 for the adult set of teeth is consistent with previous research findings. The total DMF (8.92) and filled component (0.92) were both greatest in the oldest age group (over 16). (6.07). Massoni *et al*. found that total DMF increased with age but with a smaller component [22].

When comparing CP children and healthy controls across all ages on the DMFT/dmft, no statistically significant differences were seen in caries experience. The DMFT was significantly greater in CP patients in Sharjah, United Arab Emirates research. In both mixed and permanent dentition, the MNI and RI of CP children were lower than those of the healthy control participants. These findings highlight the critical need for dental care among this population. But compared to non-CP children, CP kids had a greater MNI in their primary teeth. According to Sinha s research, there are 82% of dental defects in children with CP [23].

It's common knowledge that plaque builds up on teeth and leads to cavities and gum disease. The fact that it's challenging for carers to ensure their charges practice good dental hygiene is also pertinent to this discussion8. Factors that affect both toothbrushing and biofilm control include motor and intellectual disabilities, the presence of pathological oral reflexes such as biting and vomiting, the

posture of the child while conducting oral hygiene, and changes in intraoral sensitivity [24].

Saliva swallowing requires a fully functional swallowing reflex. The mandible, lips, tongue, pharynx, larynx, and esophagus all work together in a complex, basic function mediated by orofacial neuromuscular networks. Difficulties in forming the food bolus, ineffective labial sealing, suction problems, increased food residue, and trouble regulating the lips, tongue, and mandible have all been linked to an increased risk of sialorrhea in children with CP. Reduced intraoral sensitivity, decreased frequency of spontaneous swallowing, dysphagia during the esophageal phase, and dental malocclusion. Sialorrhea is significantly correlated with a reduced ability to chew food and swallow in general. The prevalence and severity of sialorrhea are also affected by three other characteristics that are frequent in people with CP: an open mouth position, poor body posture (especially of the head), intellectual difficulties, emotional condition, and level of attention [25].

Conclusion

Dental defects such as caries, periodontal disease, and erosion are commonly found among pediatric patients having cerebral palsy.

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Conflict of interest: None

Financial support: None

Ethics statement: This study fulfills the ethical requirements of Riyadh Elm University.

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