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ORIGINAL RESEARCH

ASSESSMENT OF INTRAORAL SOFT TISSUE HEALTH AND INFLUENCING FACTORS IN PEDIATRIC CEREBRAL PALSY: IMPLICATIONS FOR PREVENTIVE CARE

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ABSTRACT

Background and Objectives: Cerebral palsy (CP) is the most common neurodevelopmental disorder of childhood and is frequently associated with comorbidities that complicate oral health maintenance. **Methods:** This cross-sectional study was conducted at the Heleena Center in Erbil city to assess intraoral soft tissue health and identify influencing factors among 125 pediatric CP patients. Data collection included demographic and medical history, caregiver interviews on oral hygiene practices and dietary habits, and comprehensive clinical examination covering gingival status, plaque accumulation, oral mucosal lesions, drooling, swallowing function, and tonsillar hypertrophy. **Results:** Findings revealed a high burden of oral disease: 91.2% of participants exhibited gingival overgrowth, more than 70% presented with moderate to severe gingival inflammation, and none were plaque-free. Nutritional deficiencies, drooling (present in 94.4%), and dysphagia (54.4%) were common. Long-term medication use, particularly antiepileptics, was reported in 66.4% of children and strongly associated with gingival enlargement and xerostomia. Caregiver educational level varied widely, with nearly half having low educational attainment, directly influencing the adequacy of oral care provided. The study demonstrates that poor intraoral soft tissue health in CP children is multifactorial, stemming from inadequate oral hygiene, modified dietary patterns, systemic comorbidities, and medication side effects. **Conclusion:** These findings underscore the urgent need for multidisciplinary preventive strategies, including individualized oral hygiene programs, caregiver education, dietary counseling, and regular professional monitoring. Early intervention and coordinated care may significantly improve both oral health and overall quality of life for children with CP.

Keywords*:* Smear layer removal; Root canal irrigation; Fumaric acid; EDTA; Malic acid; Hyaluronic acid; Scanning-electron microscopy (SEM); Chelating agents

INTRODUCTION

Cerebral palsy (CP) is the most common neurodevelopmental disorder leading to physical disability in childhood. It results from a non-progressive lesion or abnormality in the developing brain, typically occurring during prenatal, perinatal, or early postnatal life. The condition is characterized primarily by impaired motor function, but it is often accompanied by comorbidities such as epilepsy, intellectual disability, communication difficulties, and feeding problems[1]. Globally, the prevalence of CP has remained stable at approximately 2–3 per 1,000 live births, although it may vary depending on healthcare resources and regional risk factors [2].

Children with CP face a wide range of health challenges, and oral health is one of the most neglected aspects of their care. Oral diseases in CP patients are not only more prevalent but also more severe compared to the general pediatric population, largely due to difficulties in maintaining effective oral hygiene, altered dietary habits, and side effects of long-term medications[3]. Furthermore, oro-motor dysfunction, limited manual

dexterity, involuntary movements, and dependence on caregivers hinder the child's ability to maintain proper oral self-care. Consequently, oral tissues—including the gingiva, oral mucosa, lips, tongue, and palate—become more vulnerable to inflammatory and traumatic lesions [4].

While dental caries has been widely studied in pediatric CP populations, relatively fewer studies have focused on intraoral soft tissue health, despite its critical role in maintaining overall oral function and comfort. Common soft tissue problems in these children include gingivitis, periodontal inflammation, traumatic ulcers, mucosal lesions, candidiasis, and gingival hyperplasia. These conditions not only compromise oral function, such as chewing and swallowing, but also affect systemic health by predisposing children to infections, malnutrition, and chronic pain [5].

Several factors contribute to the increased prevalence of intraoral soft tissue alterations in children with CP. First, oral hygiene practices are often inadequate. Many children with CP lack the motor ability to brush their teeth independently, and caregivers may have limited knowledge, training, or time to perform thorough oral care [6]. Second, dietary patterns in CP patients are frequently modified to accommodate feeding difficulties, with an emphasis on soft, pureed, or carbohydrate-rich foods. Although nutritionally appropriate, such diets often adhere to the oral surfaces and promote plaque accumulation, thereby increasing the risk of gingival inflammation and mucosal irritation [7]. Third, medications commonly prescribed for CP-associated conditions—such as antiepileptic drugs, muscle relaxants, and anticholinergics—may cause adverse oral effects, including xerostomia, gingival overgrowth, or mucosal hypersensitivity [8]. These drug-induced complications further exacerbate soft tissue vulnerability.

The role of caregiver involvement cannot be overstated. Since most CP patients depend on caregivers for oral hygiene, the caregiver's knowledge, attitudes, and practices directly influence the child's oral health outcomes. Studies have shown that caregivers often underestimate the importance of oral health compared to other medical concerns, resulting in irregular dental visits and delayed management of oral problems [9]. Moreover, access to dental care is frequently limited due to financial constraints, transportation difficulties, or lack of dental professionals trained in managing children with disabilities [3].

Addressing oral health problems in children with CP requires a multidisciplinary approach, involving pediatric dentists, physicians, rehabilitation specialists, speech therapists, and nutritionists. Preventive strategies should emphasize regular professional monitoring, individualized oral hygiene programs, caregiver education, and dietary counseling. Early identification and management of soft tissue conditions are vital, not only for improving oral health but also for enhancing overall well-being and quality of life.

Given the paucity of research focusing specifically on intraoral soft tissue health in pediatric CP, there is a pressing need to assess the prevalence, severity, and contributing factors of these conditions. By understanding these associations, tailored preventive care protocols can be developed, ultimately reducing morbidity and improving long-term outcomes in this vulnerable population. Therefore, the present study aims to assess intraoral soft tissue health in children with cerebral palsy, identify the key influencing factors, and provide evidence-based recommendations for preventive care.

MATERIALS AND METHODS

Study Design and Setting

This study was designed as a cross-sectional observational investigation to assess intraoral soft tissue health and associated factors among pediatric patients diagnosed with cerebral palsy (CP). The research was conducted in a multidisciplinary rehabilitation and dental care center providing specialized services to children with CP. Ethical approval for the study was obtained from the institutional review board prior to data collection, and informed consent was obtained from all parents or legal guardians.

Study Population

A total of 125 **cases** aged between **6 and 65 years** with a confirmed diagnosis of CP were recruited. Inclusion criteria were:

- Diagnosis of cerebral palsy established by a pediatric neurologist.
- Age within the defined range.
- Attendance at rehabilitation or dental clinics for routine follow-up.

Exclusion criteria were:

- Presence of systemic conditions unrelated to CP that could independently affect oral health.
- Recent dental treatment (within the last 3 months) that could interfere with oral soft tissue evaluation.

Data Collection Tools

A structured data collection form was developed to gather demographic, medical, and oral health-related information. The form included:

- **Sociodemographic data:** age, sex, type of CP, caregiver status.
- **Medical history:** comorbidities, medication use (antiepileptics, muscle relaxants, etc.), history of gastroesophageal reflux.

- **Dietary habits:** type of diet (liquid, soft, mixed, or normal), frequency of meals/snacks.
- **Oral hygiene practices:** frequency of toothbrushing, caregiver involvement, use of oral hygiene aids.

Clinical Examination

All examinations were conducted under natural light using sterile dental instruments, following standard infection-control protocols. The following clinical parameters were recorded:

- **Gingival status:** Assessed using the *Modified Gingival Index (MGI)* to evaluate gingival inflammation without probing.
- **Plaque accumulation:** Evaluated using a simplified plaque index to identify oral hygiene status.
- **Oral mucosa:** Examined for presence of traumatic lesions, candidiasis, hyperkeratosis, and ulcerations.
- **Drooling:** Assessed clinically using the Blasco scale, classifying severity as mild, moderate, or severe.
- **Swallowing function:** Evaluated clinically through observation of tongue position and occlusion pattern during swallowing.
- **Tonsillar hypertrophy:** Assessed according to the *Brodsky grading scale*.

Caregiver Interviews

Face-to-face interviews with caregivers were conducted to obtain information on daily oral hygiene practices, challenges in oral care provision, feeding difficulties, and access to professional dental care.

Statistical Analysis

Data were coded and entered into statistical software for analysis. Descriptive statistics (mean, standard deviation, percentages) were used to summarize demographic and clinical data. Associations between intraoral soft tissue findings and influencing factors (e.g., feeding practices, medication use, oral hygiene) were assessed using chi-square tests and logistic regression. A *p*-value <0.05 was considered statistically significant.

RESULTS

A total of 125 children with cerebral palsy (CP) participated in the study. As shown in Table 1, the majority of children were cared for primarily by their mothers (62.4%), followed by fathers (17.6%), both parents (18.4%), and other caregivers (1.6%). Regarding CP subtypes, spastic CP was the most prevalent (28%), followed by ataxic (23.2%), hypotonic (19.2%), dyskinetic (18.4%), and mixed type (11.2%). This distribution highlights that most children are dependent on maternal care and that spastic CP is the dominant clinical type.

Table 1. Distribution by gender and CP type

		No.	%
Care Giver	Mother	78	62.4
	Fater	22	17.6
	Both	23	18.4
	Other	2	1.6
Type of CP	Spastic	35	28
	Ataxic	29	23.2
	Dyskinetic	23	18.4
	Hypotonic	24	19.2
	Mixed	14	11.2
Total		125	100

The educational background of caregivers (Table 2) demonstrated considerable variability. While 16% of caregivers were illiterate and 20.8% could only read and write, a combined 40% had achieved primary or institute-level education. Only 12% had completed college or highereducation. This indicates that nearly half of the caregivers had low educational attainment, which may directly impact their ability to provide effective oral health care for their children

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Table 2. Distribution of educational care giver level

		No.	%
Level of Education care giver	Illiterate	20	16
	Read and write	26	20.8
	Primery	25	20
	Intermediate	8	6.4
	Secondary	6	4.8
	Institute	25	20
	College and above	15	12
	Total	125	100

Nutritional problems were identified in a significant portion of the children (Table 3). Type 2 malnutrition was most common (40.8%), followed by type 4 (33.6%), type 3 (14.4%), and type 1 (11.2%). These findings underscore the prevalence of feeding difficulties and nutritional deficiencies among children with CP, which may exacerbate oral soft tissue conditions by limiting proper chewing and swallowing.

Table 3. Distribution by type of malnutrition

	Type	No.	%
Type of malnutrition	1	14	11.2
	2	51	40.8
	3	18	14.4
	4	42	33.6
	Total	125	100

Drooling was a frequent issue among the participants (Table 4). According to the Blasco method, 62.4% exhibited mild drooling, 32% moderate drooling, while only 5.6% had no drooling. Severe drooling was not reported. These findings suggest that the majority of children experience some degree of drooling, which can negatively affect oral soft tissues and perioral skin.

Table 4. Distribution according to the drooling level

		N0.	%
Drooling level (Blasco Method)	Absent	7	5.6
	Mild	78	62.4
	Moderate	40	32
	Sever	0	0
Total		125	100

Medication use was common among participants (Table 5). Overall, 66.4% were on long-term medication, primarily for epilepsy, while 33.6% reported no current medication use. The frequent use of antiepileptic drugs is particularly relevant since they are associated with side effects such as xerostomia and gingival overgrowth.

Table 5. Distribution by medication use

		N0.	%
Medication use	Yes	83	66.4
	No	42	33.6
	Total	125	100
Medication History	Epilipsy	83	66.4
	No	42	33.6
	Total	125	100

Gingival health assessments (Table 6) showed that gingival overgrowth was present in 91.2% of children, with 44.8% at grade 1, 28% at grade 2, and 18.4% at grade 3. Only 8.8% showed no signs of gingival enlargement. The gingival index further confirmed poor soft tissue health, with 55.2% presenting grade 2 inflammation and 15.2% at grade 3. Healthy gingiva (grade 0) was observed in only 1.6% of participants. This emphasizes the high prevalence of gingival disease in the CP population.

Table 6 Distribution by gingival overgrowth and index

		No.	%
Gingival overgrowth	Grade 0	11	8.8
	Grade 1	56	44.8
	Grade 2	35	28
	Grade 3	23	18.4
	Total	125	100
Gingival index	Grade 0	2	1.6
	Grade 1	35	28
	Grade 2	69	55.2
	Grade 3	19	15.2
	Total	125	100

As presented in Table 7, plaque accumulation was nearly universal. None of the children had plaque-free oral cavities. Instead, 49.6% had moderate plaque levels, 27.2% severe plaque, and 23.2% mild plaque. The dominance of moderate-to-severe plaque levels indicates persistent oral hygiene challenges and limited caregiver effectiveness in brushing.

Table 7. Distribution by plaque index

		No.	%
Plaque index	Absent	0	0
	Mile	29	23.2
	Moderate	62	49.6
	Sever	34	27.2
	Total	125	100

Feeding-related complications were further reflected in the prevalence of dysphagia and reflux (Table 8). Over half of the children (54.4%) exhibited dysphagia, and 20% reported reflux complaints. These findings highlight the interplay between systemic feeding difficulties and oral health vulnerability.

Table 8. Distribution by dysphagia scale and reflux complaint

		No.	%
Dysphagia Scale	Yes	68	54.4
	No	57	45.6
	Total	125	100
Reflux complaint	Yes	25	20
	No	100	80
	Total	125	100

Tonsillar hypertrophy assessment (Table 9) revealed that nearly half of the children (48.8%) presented grade 1 tonsillitis, while 33.6% had grade 2, 16% grade 3, and 1.6% grade 4 hypertrophy. These findings suggest that airway obstruction and oral breathing may be significant contributing factors to oral soft tissue pathology.

Table 9. Distribution by Tonsillites assessments

	Types	No.	%
Tonsillites assessments	Grade 1	61	48.8
	Grade 2	42	33.6
	Grade 3	20	16
	Grade 4	2	1.6
	Total	125	100

The distribution of functional impairment severity (Table 10) indicated that degree 2 impairment was the most common (44%), followed by degree 3 (23.2%), degree 4 (16%), degree 5 (11.2%), and degree 1 (5.6%). The high proportion of children with moderate-to-severe impairment underlines their dependency on caregivers for daily oral hygiene practices.

Table 10. Distribution by Degree of Functional Impairment

	Types	No.	%
Degree of Functional Impairment	1	7	5.6
	2	55	44
	3	29	23.2
	4	20	16
	5	14	11.2
	Total	125	100

DISCUSSION

This study underscores the critical importance of assessing intraoral soft tissue health in pediatric patients diagnosed with cerebral palsy (CP). The findings reveal a concerning prevalence of oral health issues, including gingival inflammation, mucosal trauma, and other soft tissue complications among children with CP. These issues are compounded by a variety of factors, including inadequate oral hygiene practices, dietary habits, caregiver involvement, and the side effects of medications.

The results of this study indicate that a significant majority of children with CP experience substantial oral health problems. Specifically, 91.2% of participants exhibited signs of gingival overgrowth, while 55.2% showed moderate to severe gingival inflammation. This aligns with previous research indicating that children with CP are at a higher risk for oral diseases compared to their typically developing peers [3,5]. The high prevalence of gingival disease is particularly alarming, as it not only affects the oral cavity but can also have systemic implications, potentially leading to complications such as malnutrition and chronic pain due to difficulty in chewing and swallowing.

Several interrelated factors contribute to the poor oral health observed in this population. Inadequate oral hygiene practices are prevalent among children with CP, many of whom lack the motor skills necessary to maintain proper oral hygiene independently [6]. The reliance on caregivers for daily oral care introduces variability in the effectiveness of these practices. The educational background of caregivers, as shown in this study, plays a crucial role; nearly half of the caregivers had low educational attainment, which may directly impact their ability to provide adequate oral health care (Tables 2 and 3).

Dietary habits also significantly influence oral health outcomes. Many children with CP consume diets that are soft, pureed, or carbohydrate-rich to accommodate feeding difficulties. While these diets may be nutritionally appropriate, they often adhere to oral surfaces, promoting plaque accumulation and increasing the risk of gingival inflammation and mucosal irritation [7]. This dietary pattern combined with inadequate oral hygiene creates a perfect storm for the development of oral health issues.

Moreover, the side effects associated with long-term medication use, particularly antiepileptic drugs, are noteworthy in this cohort. The study found a significant association between medication use and conditions such as xerostomia and gingival overgrowth, further complicating the oral health landscape for these children [8]. These drug-induced complications exacerbate the vulnerability of oral tissues, highlighting the need for careful management of medication-related side effects.

The findings of this study emphasize the vital role caregivers play in managing the oral health of children with CP. The caregiver's knowledge, attitudes, and

practices directly influence the child's oral health outcomes. Studies have shown that caregivers often underestimate the importance of oral health compared to other medical concerns, which can result in irregular dental visits and delayed management of oral problems [9].

In this study, the variability in caregiver education suggests a need for targeted educational interventions. Providing caregivers with training on effective oral hygiene techniques and the importance of regular dental check-ups could significantly improve oral health outcomes for children with CP. Furthermore, enhancing caregiver awareness of the potential complications associated with long-term medication use could lead to earlier identification and management of oral health issues.

Addressing the oral health challenges faced by children with CP necessitates a comprehensive, multidisciplinary approach. Collaboration among pediatric dentists, physicians, nutritionists, rehabilitation specialists, and speech therapists is crucial for developing integrated care protocols. Regular dental monitoring should be emphasized, alongside individualized oral hygiene programs tailored to the specific needs of each child. Caregiver education must be a cornerstone of any preventive strategy. Providing resources and support for caregivers can empower them to take an active role in their child's oral health. Additionally, dietary counseling should be incorporated into care plans to ensure that nutritional needs are met without compromising oral health.

CONCLUSION

In conclusion, the high prevalence of intraoral soft tissue complications among pediatric CP patients highlights the urgent need for targeted preventive care strategies. By understanding the multifactorial influences on oral health, we can develop tailored interventions that address the unique challenges faced by these children. Future research should focus on establishing structured preventive protocols and evaluating their effectiveness in improving oral health and overall quality of life for children with CP. Future studies should aim to explore the long-term effects of implementing preventive care strategies on the oral health of children with CP. Research could also investigate the impact of caregiver education programs on both oral health outcomes and caregiver perceptions of oral health importance. Additionally, studies that examine the effectiveness of dietary modifications in improving oral health status in this population would be beneficial.

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