Evaluation of Periodontal Status and Detection of *Dialister pneumosintes* in Cerebral Palsy Individuals: A Case–Control Study

**Abstract**

**Background:** The worldwide prevalence of cerebral palsy among live births is estimated to be between 1.9 and 3.6/1000. The presence of periodontal disease in cerebral palsy children typically is due to bacterial plaque accumulation caused by their inability to correctly clean their own teeth, difficulties in chewing and swallowing food, and improper movements of masticatory muscles and tongue muscles. **Objectives:** The objective of this study is to estimate the periodontal status in cerebral palsy individuals and evaluate the presence of *Dialister pneumosintes*. **Materials and Methods:** Thirty cerebral palsy children from the Spastics Society of Tamilnadu with signs of periodontitis were compared with the same number of age- and gender-matched controls for oral hygiene and periodontal parameters. Subgingival plaque samples were screened for the presence of respiratory pathogen *D. pneumosintes* by polymerase chain reaction (PCR). **Results:** A variation was noted between types of cerebral palsy individuals with a mean probing pocket depth value of 6 in spastic type, 4.86 in the ataxic, and 4.3 in the dyskinetic. Clinical attachment level varied from 6.71 in spastic to 5.43 in ataxic and 3.50 in dyskinetic. Oral hygiene index-simplified ranged from 2.764 in spastic to 2.25 in ataxic and 1.41 in dyskinetic. PCR results indicated 25% and 21.7% positivity for *D. pneumosintes* among cerebral palsy and control group, respectively. The odds ratio calculated to estimate the risk of periodontitis due to *D. pneumosintes* was 0.765. **Conclusion:** It was concluded that oral hygiene status and severity of periodontitis worsens as the rigidity and muscle tone limiting limb movement increases in cerebral palsy individuals. **Keywords:** Cerebral palsy, *Dialister pneumosintes*, oral hygiene, periodontitis

**Introduction**

Cerebral palsy is a range of nonprogressive syndromes of postural and motor impairments that result from an insult to the developing central nervous system (CNS) in early childhood.[1] The motor disorders of cerebral palsy are often accompanied by disturbances of sensation, cognition, communication, perception, behavior, and/or by a seizure disorder. The causes of cerebral palsy may be perinatal anoxia, prematurity, prenatal infection, such as rubella, toxoplasmosis, cytomegalovirus, or postnatal infection, such as meningoencephalitis. According to the type of motion alteration presented by the child, various types of cerebral palsy can be observed: spastic, atetoid, ataxic, and mixed. The presence of periodontal disease in cerebral palsy children typically is due to bacterial plaque accumulation caused by their inability to correctly clean their own teeth, difficulty in chewing and swallowing food, and improper movements of masticatory muscles and tongue muscles.[2] These same patients often are at risk for pneumonia secondary to aspiration. Increased colonization of the oral cavity by respiratory pathogens can be a serious concern, and maintenance of adequate oral hygiene to minimize bacteria levels and gingival inflammation is important. This study aims to compare the oral hygiene, periodontal status among cerebral palsy cases, and age/gender-matched controls and detect the presence of *Dialister pneumosintes* in the subgingival plaque.

**Materials and Methods**

A total of 500 cerebral palsy individuals were examined from the Spastics Society of Tamil Nadu of which 30 with signs of chronic periodontitis were compared with the same number of age- and gender-matched controls. The inclusion criteria were participants above 12 years of age with cerebral palsy, a full mouth examination, and a positive clinical diagnosis and/or positive microbiological test results for *D. pneumosintes*. The study aimed to estimate the periodontal status among cerebral palsy individuals and evaluate the presence of *D. pneumosintes*.

**References**

1. Chandrasekaran SC, Mahalakshmi K, Padmavathy K. How to cite this article: Mohammed SR, Anand N, Chandrasekaran SC, Mahalakshmi K, Padmavathy K. Evaluation of periodontal status and detection of *Dialister pneumosintes* in cerebral palsy individuals: A Case–Control study. Indian J Dent Res 2018;29:768-72.

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**Access this article online**

Website: www.ijdr.in

DOI: 10.4103/ijdr.IJDR_582_15

**How to cite this article:** Mohammed SR, Anand N, Chandrasekaran SC, Mahalakshmi K, Padmavathy K. Evaluation of periodontal status and detection of *Dialister pneumosintes* in cerebral palsy individuals: A Case–Control study. Indian J Dent Res 2018;29:768-72.
with more than 14 permanent teeth and a probing pocket depth >5 mm or clinical attachment loss >3 mm in two or more interproximal sites not on the same tooth. Age- and gender-matched healthy individuals were taken as controls with no probing pocket depth, clinical attachment loss, and systemic illness. Medical history was taken and informed consent was obtained. Cerebral palsy children <12 years, individuals who showed no signs of chronic periodontitis, and noncompliant were excluded from the study. The periodontal examination was done using Williams periodontal probe, and clinical parameters, namely, oral hygiene index (OHI), probing pocket depth, and clinical attachment level were determined. Microbiological analysis of plaque samples was assessed by polymerase chain reaction (PCR) for the presence of respiratory pathogen D. pneumosintes. Institutional ethical clearance was obtained and informed consent from the parents was procured.

DNA extraction and polymerase chain reaction detection
The deepest pockets were selected for the sample collection and teeth were isolated for each child; subgingival plaque samples are taken from the bottom of periodontal pockets from the deepest sites with a sterile Gracey curette after removal of the supragingival plaque. The plaque was dislodged from the curette by gentle rotation in a vial containing 500 µl of sterile phosphate-buffered saline. The samples obtained were centrifuged. The supernatant was discarded. To the deposit, 200 µl of lysis buffer was added, vortexed, boiled for 10 min, and microcentrifuged at 10,000 rpm for 3 min. The supernatant was stored at −20°C until assay. Ten microliter of the supernatant was directly used as template for PCR. A representative PCR product of 16S rDNA gene of D. pneumosintes (1,105-bp size) was given to Xcelris Labs Ltd. Ahmedabad, India, for sequencing by Applied Biosystem (ABI) 3130 Genetic Analyzer (ABI PRISM BigDye Terminators V 3.1). Nucleotide sequences were visualized with Bioedit and submitted to the BLASTN program for comparison with sequences from the GenBank database. The sequenced products unveiled nucleotide identities ≥99% with the corresponding taxa when blasted in the GenBank database. The sequence for 16S rDNA of D. pneumosintes was submitted to GenBank under the accession no KT426540.

**Statistical analysis**

Pearson’s Chi-square test was done to assess the significance between two groups for the presence of D. pneumosintes. P < 0.05 was considered to be statistically significant. Odds ratio and risk ratio were calculated using Chi-square test.

**Results**

The background characteristics indicate a mean age of 17 years in the study group with a probing pocket depth of 5.28 and clinical attachment level of 5.18 and a fair oral hygiene score (2.25) [Table 1]. A variation is noted between types of cerebral palsy individuals with a mean probing pocket depth value of 6 in spastic type, 4.86 in the ataxic, and 4.3 in the dyskinetic [Table 2]. Clinical attachment level varies from 6.71 in spastic to 5.43 in ataxic and 3.50 in dyskinetic [Table 2]. OHI-simplified ranges from 2.764 in spastic to 2.25 in ataxic and 1.41 in dyskinetic [Table 2]. ANOVA of parameters between types of cerebral palsy individuals does not indicate clinically significant difference [Table 3]. The percentage positivity for D. pneumosintes in the study group and control was 25 and 21.7, respectively [Table 4]. The odds and risk ratio calculated to estimate the risk of periodontitis due to D. pneumosintes is 0.765 and 0.867 [Table 4].

**Discussion**

Periodontal disease is a chronic condition caused by many factors which leads to the destruction of the dental support system. It is usually more prevalent in the adult phase of life. However, several systemic disorders considerably increase a patient’s predisposition to suffer periodontal disease, which can develop even faster and more aggressively than in earlier ages.

Different authors have recently combined two important concepts: susceptibility and periodontal disease. They indicate that not all individuals develop the disease or lesions in the teeth support tissues in the same way; thus, there are many variations at an interpersonal level.[3] One of the conditions which favor the appearance of the periodontal disease is the presence of some kind of disability or a medical condition in patients. This makes the disease progress without any apparent cause or...
Table 2: Variation of probing pocket depth, clinical attachment level, and oral hygiene index-simplified arranging different types of cerebral palsy

|                     | n  | Mean | SD  | SE  | 95% CI for mean | Minimum | Maximum |
|---------------------|----|------|-----|-----|-----------------|---------|---------|
|                     |    |      |     |     | Lower bound     |         |         |
|                     |    |      |     |     | Upper bound     |         |         |
| Highest PPD         |    |      |     |     |                 |         |         |
| Nil                 | 30 | 5.17 | 1.931| 0.353| 4.45            | 3       | 8       |
| Ataxic              | 7  | 4.86 | 1.069| 0.404| 3.87            | 4       | 6       |
| Dyskinetic          | 6  | 4.33 | 1.862| 0.760| 2.38            | 3       | 8       |
| Spastic             | 17 | 6.00 | 1.871| 0.454| 5.04            | 3       | 8       |
| Total               | 60 | 5.28 | 1.860| 0.240| 4.80            | 3       | 8       |
| CAL                 |    |      |     |     |                 |         |         |
| Nil                 | 30 | 4.60 | 3.802| 0.694| 3.18            | 1       | 11      |
| Ataxic              | 7  | 5.43 | 3.359| 1.270| 2.32            | 2       | 9       |
| Dyskinetic          | 6  | 3.50 | 3.728| 1.522| 0.41            | 1       | 11      |
| Spastic             | 17 | 6.71 | 4.356| 1.056| 4.47            | 1       | 11      |
| Total               | 60 | 5.18 | 3.964| 0.512| 4.16            | 1       | 11      |
| OHI-S               |    |      |     |     |                 |         |         |
| Nil                 | 30 | 2.133333 | 1.3580750| 0.2479494| 1.626220 | 2.640447 | 0.7000 | 4.3000 |
| Ataxic              | 7  | 2.257143 | 1.1702666| 0.4423192| 1.174827 | 3.339459 | 1.2000 | 3.7000 |
| Dyskinetic          | 6  | 1.416667 | 0.8471521| 0.3458484| 0.527635 | 2.305698 | 0.7000 | 3.1000 |
| Spastic             | 17 | 2.764706 | 1.2358910| 0.2997476| 2.129269 | 3.400142 | 0.9000 | 4.1000 |
| Total               | 60 | 2.255000 | 1.2941099| 0.1670689| 1.920696 | 2.589304 | 0.7000 | 4.3000 |

SD=Standard deviation, SE=Standard error, CI=Confidence interval, PPD=Probing pocket depth, CAL=Clinical attachment level, OHI-S=Oral hygiene index-simplified

Table 3: ANOVA of parameters between types of cerebral palsy individuals

|                     | Sum of squares | df  | Mean square | F    | P   |
|---------------------|---------------|-----|-------------|------|-----|
| Highest PPD         |               |     |             |      |     |
| Between groups      | 15.826        | 3   | 5.275       | 1.568| 0.207|
| Within groups       | 188.357       | 56  | 3.364       |      |     |
| Total               | 204.183       | 59  |             |      |     |
| CAL                 |               |     |             |      |     |
| Between groups      | 67.040        | 3   | 22.347      | 1.455| 0.237|
| Within groups       | 859.944       | 56  | 15.356      |      |     |
| Total               | 926.983       | 59  |             |      |     |
| OHI-S               |               |     |             |      |     |
| Between groups      | 9.078         | 3   | 3.026       | 1.888| 0.142|
| Within groups       | 89.731        | 56  | 1.602       |      |     |
| Total               | 98.809        | 59  |             |      |     |

PPD=Probing pocket depth, CAL=Clinical attachment level, OHI-S=Oral hygiene index-simplified

maintains/increases the severity of an already determined condition. The main factors involved are the alterations in the immunologic system, the hormonal system, or in the connective tissue, together with a lack of hygiene.[4]

Handicap is the loss or limitation of opportunities to take part in the normal life of the community on an equal level with others due to physical and social barriers.[5] Oral health may have a low priority in the context of these pressures and other disabilities, which are more life threatening.[6] Evidence confirms that uptake of screening services for cerebral palsy individuals is the inadequacy of the plaque removal from the teeth.

Pieper et al.[10] concluded that disabled children experience greater challenges to proper oral hygiene and health care, often due to a lack of basic manual skills and intellectual abilities that preclude adequate practices, such as toothbrushing. The degree of periodontal disease among this group was higher because of the difficulty to maintain oral hygiene without visual feedback of seeing whether plaque had been removed or gums were bleeding while brushing. Thirty-two percent among them showed a pocket depth of 4–5 mm, and 8.7% showed loss of attachment of 4–5 mm.
Table 4: Percentage of Dialister pneumosintes in cases and controls and risk estimation

| PCR results | Treatment group       | Total | Value | 95% CI | Lower | Upper |
|-------------|-----------------------|-------|-------|-------|-------|-------|
|             | Cases                 | Controls | OR    | 0.765 | 0.277 | 2.114 |
| Positive    | Count                 | 15     | 13    | 28    | 25.0  | 21.7  |
|             | Percentage of total   | 25.0   | 21.7  | 46.7  | 25.0  | 21.7  |
| Negative    | Count                 | 15     | 17    | 32    | 25.0  | 28.3  |
|             | Percentage of total   | 25.0   | 28.3  | 53.3  | 25.0  | 28.3  |
| Total       | Count                 | 30     | 30    | 60    | 30.0  | 30.0  |
|             | Percentage of total   | 50.0   | 50.0  | 100.0 | 50.0  | 50.0  |

OR=Odds ratio, CI=Confidence interval, PCR=Polymerase chain reaction

Mitsne et al.\cite{11} concluded that the treatment needs regarding both dentitions are extremely high, especially in individuals with mental retardation, and the highest rate of malocclusion is observed in individuals with cerebral palsy.\cite{11} Al-Qahtani and Wyne, in their study, highlighted that more attention has to be given to the dental needs of these individuals.\cite{12} Ameer et al.\cite{13} assessed the oral hygiene status, oral hygiene practices, and periodontal status among 14–17-year-old visually impaired, deaf and dumb, intellectually disabled, physically challenged and normal teenagers. The disabled groups showed poor oral hygiene and higher incidence of periodontal disease, which may be attributed to the lack of coordination, understanding, physical disability, or muscular limitations.

Cerebral palsy can be defined as a disorder of aberrant control of movement and posture, appearing early in life secondary to a CNS lesion or dysfunction that is not the result of a recognized progressive or degenerative brain disease.\cite{14} Cerebral palsy patients present a reduced self-cleaning function of the oral cavity, due to the account of drooling and abnormal movements of the tongue and facial muscles. Individuals with cerebral palsy have poorer oral health than controls and are not provided with needed oral health care. Poor oral hygiene frequency is cited as a problem affecting the oral health status of individuals who have cerebral palsy.\cite{15}

The ability to maintain adequate oral hygiene is complicated by many factors, including dyskinetic movements, the presence of pathologic oral reflexes (biting and vomiting), and the inability to manipulate a toothbrush. Reilly S reported the prevalence of various gastrointestinal disorders as high as 90% in populations of children who have cerebral palsy. These disorders can include dysphagia, gastroesophageal reflux, gastritis, chronic pulmonary aspiration, and constipation. Gastroesophageal reflux disease (GERD) has an increased prevalence in individuals who have neuromuscular disorders.\cite{16} Untreated GERD can lead to erosive esophagitis, increased bronchial aspiration, and malnutrition.\cite{17}

Individuals who experience chronic pooling of saliva tend to build up extensive calculus deposits and are at risk for pneumonia secondary to aspiration. Increased colonization of the oral cavity by respiratory pathogens can be a serious concern, and maintenance of adequate oral hygiene to minimize bacteria levels and gingival inflammation is important.\cite{18}

The present study reveals that the study population had a mean age of 17 years with an average probing pocket depth of 5.28 and clinical attachment level of 5.18. A fair oral hygiene (2.25) is noted in the sample population. D. pneumosintes, a nonfermentative, anaerobic, Gram-negative rod primarily, a respiratory pathogen, has been recovered from deep periodontal pockets. Microbiological analysis in this study showed that 25% of the cases were positive for D. pneumosintes and 21.7% of the controls were positive for the same. The odds ratio calculated to estimate the risk of periodontitis due to D. pneumosintes is 0.765. These findings reiterate the fact that D. pneumosintes, a respiratory pathogen, has its presence in the subgingival plaque.\cite{19}

Comparative analysis indicates a mean probing pocket depth of 5.77 in cases and 5.17 in controls with respective standard deviation as 4.099 and 1.931. The mean clinical attachment level of 5.77 in cases and 4.6 in controls with a standard deviation of 4.099 and 3.802, respectively, was observed. The OHI was apparently fair in both groups. Notable variation in probing pocket depth and clinical attachment level was seen with an increased severity of periodontitis from dyskinetic to ataxic and maximum in spastic group. This could be due to the increased muscle tone and rigidity of the limbs in the spastic group making it difficult for the caregiver to maintain oral hygiene and health. Similarly, greater severity of periodontitis is noted in class III who have the greatest limitation in activity.

**Conclusion**

The present study indicates that oral hygiene status and severity of periodontitis worsens as the rigidity and muscle tone limiting limb movement increases in cerebral palsy individuals. On the contrary, the prevalence of respiratory pathogen D. pneumosintes in the subgingival plaque of cases and controls reveals a negative correlation to the hypothesis of the study. As the percentage prevalence of this bacterium in both the groups is similar, it could be suggestive of commensal in the oral cavity. A study with large sample size may help in further substantiation.

**Financial support and sponsorship**

Nil.
Conflicts of interest

There are no conflicts of interest.

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