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## **ORAL HEALTH STATUS AMONG CHILDREN WITH CEREBRAL PALSY IN DUBAI UNITED ARAB EMIRATES: A CASE CONTROL STUDY**

By

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## ABSTRACT

### ORAL HEALTH STATUS AMONG CHILDREN WITH CEREBRAL PALSY IN DUBAI, UNITED ARAB EMIRATES: A CASE CONTROL STUDY

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Associate Professor Amar Hasan

#### **Aim:**

The purpose of this study was to assess the oral health status of children with Cerebral Palsy (CP) in Dubai, United Arab Emirates (UAE).

#### **Materials and Methods:**

84 CP children (mean age =  $9.33 \pm 3.89$ ) and 125 healthy children (mean age =  $9.30 \pm 2.68$ ) were recruited from special needs centres, along with private/public schools in Dubai. A dental examination including caries assessment using dmft/DMFT indices, oral hygiene assessment using the Simplified Oral Hygiene Index, calculus index and oral debris index was conducted. In addition, assessments of occlusal anomalies, dentofacial abnormalities, soft tissue abnormalities, and erosion were conducted.

#### **Results:**

The mean number of DMFT/dmft scores of CP children were comparable to that of healthy children. The Met Need Index (MNI) and Restorative Index (RI) in the CP group with mixed dentition scored the lowest compared with the control group. Calculus Index (CI) was found to be significantly higher among children with CP ( $0.56 \pm 0.78$ ) compared with controls ( $0.07 \pm 0.27$ ) (p-

value < 0.001). The proportion of debris was significantly lower among children with CP; 57 (69.5%) compared with 110 (88%) in the healthy controls (p-value =0.001). CP subjects had a significantly higher proportion of anterior open bite compared to the control group (29.3% vs 11.2%, respectively) (p value = 0.001), anterior spacing (50% vs 32%) (p value = 0.007) and trauma (31.7% vs 3.2%) (p value < 0.001). Class II molar Angle malocclusion was significantly higher in CP (80.7%) compared to controls (25.5%) (p value < 0.001). CP individuals had remarkably increased frequencies of dentofacial anomalies such as high arched palate, tongue thrust, and lymphadenopathy compared to controls. In addition, CP subjects had significantly higher proportion of oral soft tissues' anomalies such as angular cheilitis, macroglossia, and drooling. Moreover, erosion was significantly higher among CP children relative to healthy controls (42.7% vs 15.2%, p-value < 0.001)

### **Conclusions:**

The findings of this study revealed that CP patients had a tendency toward lower rates of caries compared to healthy children, along with lower rates of restorative and dental care. Significantly higher calculus deposits, lower debris index, and comparable oral hygiene index were also observed. Further, different forms of malocclusion in CP children exceeded those of children without disabilities.

## DEDICATION

*This thesis is dedicated to my parents, husband and my lovely daughters  
For their endless love, support and encouragement*

## **DECLARATION**

I declare that all the content of the thesis is my own work. There is no conflict of interest with any other entity or organization.

Name: Haifa Alhashmi

Signature:

## ACKNOWLEDGMENTS

Though only my name appears on the cover of this thesis, a great many people have contributed to its production throughout the past three years. I owe my gratitude to all these people, who have made this thesis possible.

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- Dubai Rehabilitation Centre
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- Zayed Bin Sultan School
- Al Maaref Private School

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## **List of Abbreviations**

CP	= Cerebral Palsy
AACP	= The American Academy for Cerebral Palsy
HIE	= Hypoxic-ischemic encephalopathies
CMV	= Cytomegalovirus
HIV	= Human Immunodeficiency Virus
GMFS	= The Gross Motor Function Classification System
CT	= Computerized Tomography
EEG	= Electroencephalogram
EMG	= Electromyogram
ABR	= Auditory-evoked Brainstem Responses
NG	= Nasogastric
GE	= Gastroesophageal
GT	= Gastrostomy Tube
BPE	= Basic Periodontal Examination
NICE	= National Institute for Clinical Excellence
WHO	= World Health Organization

DHCC	= Dubai Health Care City
UAE	= United Arab Emirates
GCP	= Good Clinical Practice
NICE	= National Institute for Clinical Excellence
D	= Decayed
M	= Missing
F	= Filled
RI	= Restorative Index
MNI	= Met Need Index

## 1. Introduction

Cerebral palsy (CP) is a group of neuromuscular disorders which affect the development of movement and posture, causing activity limitations. These limitations are attributable to non-progressive disturbances which have occurred in the developing infant brain. Such disturbances include infection, hypoxia, trauma, and hyperbilirubinaemia; biochemical and genetic factors may also be involved <sup>1</sup>. The motor disorders of CP are often accompanied by disturbances of sensation, cognition, communication, perception, and/or by seizure disorders <sup>2</sup>.

CP may be classified into three main groups: <sup>3</sup> 1) spastic, characterized by increased muscle tone; 2) dyskinetic, characterized by hypotonic, slow writhing movements (athetotic), abnormal postural control movements, swallowing difficulties, problems of speech and coordination; 3) ataxic, characterized by involuntary movement, lack of balance and depth perception.

CP is the most common motor disability which occurs during childhood <sup>4</sup>. Population-based studies from around the world report estimates of CP prevalence ranging from 1.5 to more than 4 per 1,000 live births or children of a defined age range <sup>5-9</sup>. In the industrialized nations, the prevalence of cerebral palsy is approximately 2 per 1000 live births <sup>10</sup>. In the United States, approximately 10,000 infants and babies are diagnosed with CP each year, and a further 1200–1500 are diagnosed at preschool age <sup>10</sup>.

The prevalence of CP in the developing world is not well established, but estimated to be 1.5 - 5.6 cases per 1,000 live births<sup>11</sup> . There are no available studies to indicate the prevalence of CP in the United Arab Emirates (UAE), although experience from practice indicate that it is comparable to that of Western populations <sup>12</sup> .

Several studies reviewed by Dougherty, *et al.* concluded that patients with cerebral palsy have several oral health problems <sup>3</sup> . Neuromuscular disturbances can affect oral health significantly; they may result in changes of the oro-facial region's structure, and may affect the development of para-functional habits, including feeding problems, difficulty maintaining oral hygiene, and barriers to oral care access.

According to several authors, people with cerebral palsy are reported to have poor oral hygiene, bruxism <sup>13,14</sup> , drooling <sup>15,16</sup> , traumatic dental injuries <sup>17</sup> , and malocclusion<sup>17,18</sup> .

Many conflicting reports are observed in the literature with regard to the dental caries experience of this group of individuals: some authors report an increased prevalence of dental caries <sup>14,19,20</sup> while others report that children with cerebral palsy suffered from a greater prevalence of dental caries in the primary dentition than normal children <sup>21</sup> . In contrast to these studies, other studies have found a lower prevalence of caries in children with CP compared to normal populations,<sup>22</sup> and others have reported that both children with and without cerebral palsy had similar caries experiences <sup>23</sup> .

Periodontal disease has been reported to be common among older children with CP due to poor oral hygiene resulting from oral habits, physical disability, malocclusion, and gingival hyperplasia<sup>24</sup>. In addition, other studies have found high prevalence of gingivitis in CP children compared with healthy children<sup>13,25</sup>. Another study concluded that the prevalence of periodontal disease in the CP group was similar to that of healthy children<sup>26</sup>.

To date, there have not been any studies conducted in the UAE, in Dubai, to assess the oral health of children with cerebral palsy.

Investigating this group of special needs children will help highlight their dental health issues and re-direct national dental programs toward providing the best suitable oral health treatment to different groups, according to their needs.



## 1.1 Literature Review

### 1.1.1 Definition

Sir John Little was the first to define cerebral palsy in his famous work of 1862, though he did not apply that term at the time. William Osler, in his book “The cerebral palsy of children” (1889), defined the clinical features which presented 151 CP children, grouping them according to their expected aetiology, in order to interpret the physiopathological mechanisms of the cerebral lesion (damage location). Sigmund Freud, in his “Die infantile Cerebrallähmung” (1897) inspected the causes of these motor disorders, emphasizing the significance of pre-term birth and intrauterine development disorders <sup>27</sup>.

The American Academy for Cerebral Palsy (AACP) was founded in 1947 and considered a multidisciplinary professional association, aimed at sponsoring research in the field of infant disability.

Mutch, *et al.* (1992) defined CP as “an umbrella term covering a number of syndromes with motor deficiency, non-progressive, but often changing, secondary to brain lesions or anomalies appearing in the early stages of brain development ” <sup>27</sup>.

Another definition was then introduced in by Rosenbaun, *et al.* (2007) as follows: “Cerebral palsy (CP) describes a group of disorders of the development of movement and posture, causing activity limitation that attributed to non-progressive disturbances that occurred in the developing fetal or infant brain. The motor disorders of cerebral palsy are often accompanied by disturbances of sensation, cognition, communication, perception, and/or behaviour, and/or by a seizure disorder”<sup>27</sup>.

### 1.1.2 Prevalence

Cerebral palsy (CP) is the most common motor disability occurring during childhood<sup>4</sup>. Population-based studies from around the world report prevalence estimates of CP ranging from 1.5 to more than 4 per 1,000 live births or children of a defined age range<sup>5-9</sup>. In the industrialized world, the prevalence of cerebral palsy is about 2 per 1000 live births<sup>10</sup>. In the United States, approximately 10,000 infants and babies are diagnosed with CP each year, and a further 1200–1500 are diagnosed at preschool age<sup>10</sup>. The prevalence of CP in the developing world is not well established, however, it is estimated to be 1.5 - 5.6 cases per 1000 live births<sup>11</sup>. In Saudi Arabia, a prevalence ratio of 5.3 in every 1000 individuals was reported among the Saudi population<sup>28</sup>. While there are no available studies which indicate the prevalence of the CP in the UAE, or in particular Dubai, experts in the field indicate that it is similar in proportion to that of western populations<sup>12</sup>.

### 1.1.3 Aetiology

#### *Congenital Aetiology*

CP patients have distinctive deformities which result from defects occurring in normal development, and follow outlines based on failures of normal formation<sup>29</sup>. The earliest acknowledged deformities which lead to survival with motor defects are defects of the neural tube closure, such as meningomyelocele (the most common neural tube defect occurring in the spine). On the other hand, the neural tube defects in the brain known encephalocele may be anterior, with main midface or nasal defects<sup>30</sup>. Children with significant encephaloceles have significant motor impairments, including quadriplegic patterns associated with hypotonia, rather than hypertonia. Segmental defects in the brain known as schizencephaly refer to a cleft in the brain; such

schizencephalies vary greatly in their effects, from causing minimal disability to causing very severe quadriplegic pattern involvement, and usually present with spasticity and mental retardation<sup>31</sup> .

Primary proliferation defects of the brain result in microencephaly. Regardless, there are numerous other causes of microencephaly, most of which relate to toxins or infection <sup>29</sup> . Megaloencephaly is caused by cellular hyper-proliferation, commonly in syndromes such as sebaceous nevus syndrome, whereas macrocephaly is most often due to hydrocephalus. Throughout development neurons transfer toward the periphery of the brain, a defect in this migration pattern leads to lissencephaly, which means “smooth brain”; in other words, a child with decreased cerebral gyri. This defect usually leads to severe spastic quadriplegic pattern involvement. There is a broad-spectrum understanding that significant seizure activity in a young child may preclude synaptic remodelling through excitotoxic injury, which may lead to CP.

### *Neonatal Aetiology*

Neonatal and prenatal causes of CP are chiefly linked to prematurity and birthing problems, which lead to numerous patterns <sup>29</sup> . The general trend is that premature infants with more severe bleeds in the brain (in ventricles and the periventricular white matter areas) have a worse prognosis for survival and are at a higher risk of developing CP; nonetheless, there are no restrictions which may accurately predict the risk of developing CP, much less predict the severity of CP in an individual child. In full-term infants, hypoxic events occurring surrounding delivery usually lead to disability; these events have been called hypoxic-ischemic encephalopathies (HIE) <sup>30</sup> .

Subcortical cyst formations develop in severe cases of HIE and are called multicystic encephalomalacia. When this cystic pattern forms, the prognosis for good function is poor, with most children developing severe quadriplegic pattern involvement, with severe mental retardation. Further, some of these children develop cysts in the thalamus and basal ganglia, which may lead to dystonia <sup>30</sup>.

In the preterm or full-term infant, neonatal stroke usually affects the middle cerebral artery and presents as a wedge-shaped defect in one hemisphere. If such a wedge-shaped defect is small, the child may not be affected; similarly, a significant defect, especially with a cyst, usually presents as hemiplegic pattern CP. Despite a large cyst, these children's overall, and especially cognitive, functions may be quite good <sup>29</sup>.

### *Postnatal Causes of Cerebral Palsy*

Postnatal causes of CP may overlap to some extent with the prenatal and neonatal group; however metabolic encephalopathy, postnatal trauma, infections, and toxicities are considered as aetiologies in this group <sup>32</sup>. Child abuse, falls, or motor vehicle accidents can result in blunt head trauma and skull fractures which comprise not only the direct injury, but also the secondary injury from brain swelling. However, children with blunt trauma may recover and have no resultant motor defects <sup>33</sup>. Nevertheless, if there is a unilateral bleed in the brain, affected children are frequently left with a hemiplegic pattern motor disability. The more severely affected children are frequently left with severe quadriplegic pattern involvement and often do not become functional community ambulators. Many children with motor damage from closed head injuries suffer from ataxia as a major impairment.

A wide variety of infections leave children with permanent neurologic deficits. Prenatal and neonatal viral infections are the most common infectious cause of CP. Cytomegalovirus (CMV) leaves 90% of children with mental retardation and deafness, while only 50% develop CP or motor defects. Children who develop congenital rubella infections will commonly suffer from mental retardation; however, only 15% develop CP <sup>34</sup>. Neonatal herpes simplex infections have high mortality rates, while 30 - 60% of survivors have some neurologic sequelae; with regard to such infections, resultant CP is not common.

Infections with human immunodeficiency virus (HIV) may cause neurologic sequelae; affected children usually develop a progressive encephalopathy, and should be treated with anticipated short life expectancy. Neonatal bacterial meningitis may be caused by many organisms the effects of which may be very severe; as many as 30 - 50% of survivors suffer from CP <sup>34</sup>.

Temporary neurologic deficits can be caused by many toxic agents, alcohol being the most commonly encountered. Children with prolonged anoxic events, such as near drowning, near hanging, or near asphyxiation can make outstanding recoveries. However, when these children do not make a complete recovery, they are usually left with exceedingly severe neurologic deficits.

#### **1.1.4 Classification**

##### *Classification Based On Severity Level*

Cerebral palsy is frequently classified by severity levels mild, moderate, severe, or no CP <sup>35</sup> .

- A. Mild – A child is able to move without assistance; their daily activities are not restricted.
- B. Moderate – A child will need medication, braces, and adaptive technology in order to achieve daily activities.
- C. Severe – Severe: A child will need a wheelchair and will have substantial challenges in achieving daily activities.
- D. No CP – The child has CP signs, but the damage was acquired after the completion of brain development, and is consequently classified under the incident that caused CP, for example: traumatic brain injury or encephalopathy.

#### *Classification Based On Topographical Distribution*

Topographical classifications describe the affected parts of the body <sup>3,35,36</sup>. This is useful in establishing treatment protocols as follows: paresis (weakened), plegia/plegic (paralyzed), monoplegia/monoparesis (refers to when only one limb is affected), and diplegia/diparesis (when the lower body is principally affected; legs are affected more frequently than arms). When one side of the body is affected (arm and leg) this is referred to as hemiplegia/hemiparesis; when the lower half of the body (both legs) are affected it is called paraplegia/paraparesis.

When three limbs are affected this condition known as triplegia/triparesis. Lastly, when all four limbs are involved it is classified as quadriplegia/quadruparesis.

### *Classification Based On Motor Function*

CP is caused by brain injuries which affect motor function, as well as the ability to control the body in a normal manner<sup>3,35,37</sup>. There are two main groups, spastic and non-spastic. Each group has multiple characteristics and it is possible to have a mixture of both types.

- A. Spastic cerebral palsy is characterized by increased muscle tone.
- B. Non-spastic cerebral palsy exhibits decreased or fluctuating muscle tone.

### *Pyramidal or Spastic Cerebral Palsy*

Pyramidal CP means that the pyramidal tract is affected by upper motor neuron damage, and is either not functioning properly or is damaged. Spastic CP is hypertonic and accounts for 70% to 80% of cases. It creates stress on the body, which result in interconnected conditions such as scoliosis, hip dislocation, limb deformities, and contracture (painful joint deformities)<sup>3,35</sup>.

### *Extrapyramidal or Non-Spastic Cerebral Palsy*

Non-spastic CP manifests through decreased or fluctuating muscle tone, and is characterized by involuntary movement, which is worsened by stress and eliminated by sleep. Non-spastic CP has multiple types, which are characterized by their specific damages.

Non-spastic cerebral palsy is divided into ataxic and dyskinetic groups, which make up 20% of CP cases (with dyskinetic comprising 15%, and ataxic 5%)<sup>3,35</sup>.

A. Ataxic CP affects coordinated movements that involve balance, posture; walking gait is frequently very wide and sometimes irregular. In addition, fine motor skills requiring coordination of the eyes and hands, such as writing, are difficult.

B. Dyskinetic CP is divided into two different groups; athetoid CP – which consist of cases with involuntary movements, principally in the arms, legs, and hands – and dystonia/dystonic CP – which includes cases affecting trunk muscles more than limbs and results in a fixed, twisted posture.

### *Mixed Cerebral Palsy*

Mixed CP refers to impairments which fall into both spastic and non-spastic categories. 60% of mixed CP cases have their age of onset in an individual's thirties or later<sup>3,35</sup>.



### *Classification Based on the Gross Motor Function Classification System (GMFS)*

GMFS is composed of a five-level system that is related to the individual's extent of ability, and the limitations of their impairment(s) <sup>38</sup> . A higher number signifies a higher degree of severity. Each level is determined by age range, and a set of activities the child may achieve on their own.

GMFCS classification levels:

GMFCS Level I – “walks without limitations.”

GMFCS Level II – “walks with limitations.”

GMFCS Level III – “walks with adaptive equipment assistance.”

GMFCS Level IV – “self-mobility with use of powered mobility assistance.”

GMFCS Level V – “severe head and trunk control limitations.”

#### **1.1.5 Diagnosis**

CP is not frequently diagnosed at birth, with most children diagnosed between the ages of six months and 2 years. Infants with severe CP may have recognizable signs at birth, such as abnormal muscle tone. In addition, delayed development is usually the first sign observed in a child with CP. These infants may have abnormal muscle tone or some abnormal movements <sup>39</sup>. Children with normal development will usually be able to sit unaided at six months of age, crawl by eight months, pull to stand by 12 months, and walk by 15 months <sup>39</sup>.

There is some variety, and some children meet these developmental milestones later. Nevertheless, a child who is late in meeting these milestones should generally be evaluated for CP. Diagnosis can be made by a child specialist evaluating the symptoms, and signs of delay in development <sup>39</sup> .

### *Tests and Scans*

To rule out other problems with similar symptoms to CP, such as muscular dystrophy (a group of inherited conditions that gradually weaken the muscles), additional tests may be suggested <sup>40</sup> .

Further testing – including Magnetic Resonance Imaging (MRI) scan, Ultrasound Scan, Computerized Tomography (CT) scan, Electroencephalogram (EEG), Electromyogram (EMG), and blood tests – may be able to confirm cerebral palsy diagnoses, as the condition can cause changes to the brain's structure <sup>40</sup> .

### **1.1.6 Treatment**

The treatment for children with CP may include physical therapy, occupational therapy, speech therapy, medication, surgery, communication aids and assistive technology, vision and hearing aids, orthotic devices, and the use of other equipment <sup>41</sup> .

### *Physical Therapy*

For CP children, physical therapy is a broadly used intervention, as it is aimed at encouraging motor skills, in addition to developmental skills and functional independence <sup>42,43</sup> . Physical therapy includes exercise, muscle training, as well as the use of orthotics or braces and other equipment <sup>44,45</sup> .

### *Speech Therapy*

Many children with CP face problems with drooling and dysarthria (difficulty in articulating words caused by impairment of the speech muscles). Therefore, speech therapy for those children may help with issues related to speech, along with related feeding and swallowing problems<sup>46</sup>. Furthermore, speech therapists may make use of augmentative communication devices or sign language as instructional devices to provide additional communication services.

### *Devices and Gadgets*

Assistive technology, consisting of grab bars, magnifiers, rails, velcro grips for eating utensils and writing implements, along with voice communication devices, computer software programs, customized wheelchairs, and positioning equipment (for the correction of posture), are devices for treatments of symptoms associated with CP <sup>47-49</sup> .

### *Surgical and Medical Interventions*

The most common surgical procedures for patients with CP are performed for the treatment of scoliosis, hip dislocation, severe contractures, along with deformities in tendons, bones and joints. Tendon lengthening, or transfer, and osteomy to realign a limb, are also common procedures. Further, intraecal insertion of a baclofen pump has been shown to be suitable to decrease spasticity in the lower extremities and trunk. In this procedure, an intraspinal catheter is placed and connected to a reservoir under the skin of the abdomen <sup>41</sup> . Another relatively common surgical procedure is dorsal rhizotomy, “a procedure in which the surgeon cuts a portion of the spinal sensory roots that provides input to spastic leg muscles.”

### **1.1.7 Associated Manifestations and Complications**

#### ***Mental Retardation***

Not all children with CP are cognitively impaired. Indeed, the most common type of CP (spastic diplegic) is characterized by normal cognition, as the lesion is in the periventricular white matter. Nevertheless, there is some relationship between the severity of CP and mental retardation, as in the case of spastic quadriplegic CP patients. In addition to other factors which increase cognitive impairment (such as epilepsy, and cortical abnormalities on neuroimaging) individuals with spastic quadriplegic CP have a greater degree of mental retardation than those with spastic hemiplegia<sup>50,51</sup>.

#### ***Epilepsy***

Epilepsy can be a sign of the severity of neurological injury (quadriplegic CP) or cortical insult (hemiplegic CP). Up to 36% of children with CP have epilepsy, with 70% of cases presenting with onset in the first year of life <sup>52</sup>. However, Children with spastic diplegic CP are at a lower risk for epilepsy, as their pathology predominantly involves the periventricular white matter. Several new antiepileptic drugs have enhanced the ability to control the seizures in these children<sup>53</sup>.

### *Feeding, Nutrition, and Growth*

In children with severe CP, the most common concerns relate to feeding, nutrition, and growth. About 30% of CP children are undernourished below the third percentile. The leading cause for growth delay appears to be poor nutrition secondary to pseudobulbar palsy, an upper motor neuron disorder resulting in poor coordination in sucking, chewing, and swallowing <sup>54</sup>. In addition, gastroesophageal (GE) reflux results in regurgitation, vomiting, and possible aspiration, a source of pain and food refusals in the difficult-to-feed child. Early nasogastric (NG) or gastrostomy tube (GT) feedings can resolve these problems, with improved growth and greater family satisfaction<sup>54</sup>. NG tube feeding can be used for short-term nutritional support, though this method is generally not acceptable as it can be associated with nasal discomfort, sinusitis, and irritation of the larynx, as well as recurrent tube blockage or displacement on a long-term basis. Surgically or endoscopically placed GT can afford a long-term solution to feeding disorders, in combination with treating the associated GE reflux <sup>54</sup>.

### *Bladder Dysfunction*

Children with CP are at increased risk for urinary incontinence, urgency, and infections <sup>55</sup>. It has been reported that up to 23% of these children had Primary incontinence, which shows a relationship between lower cognition and severe motor deficits <sup>56</sup>. However, the attainment of continence can be influenced by communication skills, along with physical ability to go to the bathroom and manage clothing. Spastic CP can be associated with spasticity of the detrusor muscles, resulting in small frequent voids, and a low capacity irritable bladder. In addition, adapted toilet seats, handrails, and clothing modifications can improve the number of toileting successes.

### *Bowel Dysfunction*

In children with CP, Constipation is common and results from various factors including immobility, poor feeding, and reduced water intake. For Initiating bowel evacuation, a combination of laxatives and suppositories are recommended. Further, softening agents with dietary modifications can give rise to more regular and softer bowel movements <sup>50</sup>.

### *Sleep Disturbances*

In CP children Sleep disorders are common and occur in up to 50% of cases, namely in those with visual impairment <sup>57</sup>. The manifestations of these disorders include disturbed sleep patterns, fragmented sleep, and frequent nocturnal awakenings, which can be extremely distressing to parents. Medications which improve the sleep-wake cycle may also decrease spasticity and improve daytime behaviour <sup>57,58</sup>. Hypnotics are generally effective for short periods, but tolerance against them is built in the span of a few days.

### *Drooling*

Drooling, hypersalivation, sialorrhoea, and pty-alism are terms that have been used interchangeably throughout the literature and this has led to some confusion. Hussein et al 1998. Drooling occurs in up to 30% of cases of children with CP <sup>59</sup>, and is not usually connected to an increase in the production of saliva, if there is no aggravating lesion is present (dental caries or throat infection). Drooling is commonly secondary to mouth opening and/or swallowing difficulties resulting from pseudobulbar palsy; besides which, it is not socially acceptable and can lead to aspiration, skin irritation, and articulation difficulties <sup>59</sup>.

However, it is difficult to manage this problem effectively. Firstly anticholinergic medications such as glycopyrrolate decrease salivation by blocking parasympathetic innervation, but have the

side effects of irritability, sedation, blurred vision, and constipation <sup>60</sup>. Scopolamine, another anticholinergic agent (available as a skin patch), and surgical re-routing of salivary ducts otherwise known as the Wilkie procedure (which may potentially lead to increased aspiration) are further available options.

Recent studies suggest that botulinum toxin injection into the parotid and submandibular glands may be effective in the reduction of extreme drooling <sup>61,62</sup>.

### *Hearing Loss*

Hearing loss, if not diagnosed and treated early, can hinder developmental progress and rehabilitation in children with CP, thereby contributing to further developmental delays <sup>63</sup>. Certain aetiologies can increase the risk for hearing loss such as congenital rubella, kernicterus and post-meningitis. Screening and hearing assessment is recommended routinely for any child with developmental delay, including children with CP. These screenings may include behavioural audiometry, auditory-evoked brainstem responses (ABR), or transient evoked otoacoustic emissions <sup>63</sup>.

### *Visual Abnormalities*

Children with CP are at an increased risk for visual impairment including retinopathy, amblyopia. Strabismus, glaucoma, and myopia, which can interfere with developmental progress and rehabilitation if not diagnosed and managed early on. Accordingly, screening and serial ophthalmologic assessments are recommended routinely for any child with global developmental delays (such as CP), principally if there is suspected vision loss <sup>64</sup>.

### *Orthopaedics Abnormalities*

Developing bones grow in the direction of the forces placed upon them, thus, progressive joint contractures, shortened muscles, and hip or foot deformities can arise from spasticity. Other orthopaedic complications which must be observed include scoliosis and fractures due to osteoporosis or osteomalacia. These symptoms are more common with severe motor disability and immobility, such as quadriplegia <sup>50</sup> .

#### **1.1.8 Dental Problems**

##### *A. Dental Caries*

##### *Definition of Dental Caries According to World Health Organisation(WHO):*

“Dental caries is defined as localized post eruptive pathological process of external origin involving softening of the hard tooth tissue and proceeding to the formation of a cavity” <sup>65</sup> .

##### *Aetiology of Dental Caries*

Dental caries development involves a triad of interrelated factors: bacteria (dental plaque), fermentable carbohydrate (diet) and susceptible teeth (host) <sup>66</sup> . Recently, time has been considered a fourth factor for the development of dental caries. A modified model of the current understanding of the multifactorial aetiology of dental caries, and the interactions between these factors is presented by Navia (1994) <sup>67</sup> .



### *Dental Caries Studies Among CP Patients*

The results of several studies have been inconclusive in determining whether children with CP have a higher caries rate than other children<sup>3</sup>. Nevertheless, some studies have found that subjects with CP had higher caries as they age (represented through mixed and permanent dentition)<sup>68</sup>.

Further, the incidence of dental caries in children and adolescents with CP was high found to be high, and was associated with subject's sociodemographic, behavioural, and clinical characteristics<sup>69</sup>. A study conducted by Dury, *et al.* found that children, regardless of their CP status, had similar caries experiences<sup>23</sup>.

### *B. Periodontal Disease*

#### *Definition of The Periodontium*

“All the elements supporting the tooth, represented by cementum, periodontal membrane, alveolar bone and gingiva constitute the periodontium”<sup>65</sup>.

#### *Definition of Periodontal Disease*

“Periodontal disease are those pathological processes of an inflammatory and degenerative type that involve the periodontium, they are generally characterized clinically by gingivitis, pocket formation and loss of alveolar bone and eventually loss of teeth”<sup>65</sup>.

### *Features of A Healthy Periodontium*

Healthy children's gingiva and periodontal status is characterized by the gingival margin as several millimetres coronal to the cemento-enamel junction (CEJ), and the gingival sulcus may be 0.5-3 mm deep on a fully erupted tooth <sup>70</sup>. However, in teenagers the alveolar crest is situated between 0.4-1.9 mm apical to the CEJ (Hausmann, et al., 1991).

### *Periodontal Disease Studies Among CP Patients.*

Gingival health is often reported to be poor due to difficulties in maintaining oral hygiene, as a result of poor neuromuscular control and/or other health priorities <sup>14,71</sup>. In addition, gingivitis can arise as a result of food pouching and mouth breathing, especially in the anterior region of individuals with CP <sup>1</sup>. Furthermore, the increased prevalence of gingival overgrowth among the CP group is likely to be related to their use of anticonvulsant drugs, calcium channel blockers and immunosuppressive agents <sup>71</sup>.

In one study, children with CP were shown to have a greater prevalence of periodontal disease in the primary dentition than children in the control group <sup>71</sup>. However, another studies reported that the prevalence of periodontal disease in CP children was similar to that in healthy children<sup>26</sup>. Periodontal disease has been stated to be common particularly in older children with CP due to poor oral hygiene, problems with oral habits, physical disabilities, malocclusion, and gingival hyperplasia caused by medications for people with cerebral palsy <sup>24</sup>. Mouth breathing worsens the periodontal state, and papillary hyperplastic gingivitis may be seen even in the absence of phenytoin <sup>26</sup>.

### *C. Malocclusion*

Malocclusion plays a significant part in the overall oral health of an individual because it is linked with temporomandibular disorders (TMD), periodontal disease, and may be complicated by an individual's disability<sup>72-74</sup>. Risk for malocclusion can originate from physical, behavioural, or disease factors<sup>75,76</sup>.

The prevalence of malocclusion was higher in individuals with disabilities than in controls without disabilities. In addition, malocclusion was more common when the special need of the individuals was mental, rather than physical in origin<sup>77</sup>. In CP Individuals Class II malocclusions were the most common form of malocclusion, along with missing teeth and anterior diastema<sup>78</sup>. In addition, Children with CP have a significantly increased overjet, overbite and are likely to have incompetent lips<sup>17</sup>.

Class II malocclusions have been linked to hypotonia of the orofacial musculature, and forward thrust of the tongue<sup>13,14</sup>. Further, this type of malocclusion predisposes the individual to trauma of the anterior teeth, in addition to poor gait and seizures<sup>3</sup>.

#### *D. Non-Carious Tooth Surface Loss Among CP Patients*

##### *Types of Tooth Surface Loss (TSL)*

Tooth surface loss take either the form of attrition (“wear of the tooth surface as a result of tooth to tooth contact”), or erosion (“irreversible loss of tooth substance brought about by a chemical process that doesn’t involve bacterial action”) <sup>79</sup> .

##### *Aetiology of TSL*

###### *A. Intrinsic Acidic Sources*

These are of gastric acid origin and may be linked with significant palatal dental erosion. Secondary to gastro-oesophageal reflux (GORD), besides the fact that gastric acid enters the mouth, rumination and vomiting can cause tooth surface loss <sup>80</sup> .

##### *GORD*

GORD is “a condition defined as an involuntary passage of gastric juice against the normal flow of digestive tract” <sup>81,82</sup> . Dental erosion in relation to GORD is a less significant problem in children, perhaps due to a shorter history of GORD, or refluxing is restricted to the oesophagus<sup>83,84</sup> .

Higher levels of gastric reflux are seen in children with neurological impairments than healthy children, with over 70% of CP children having abnormal reflux activity <sup>85</sup> .

In one study, the prevalence of GORD in children with CP children was found to be 53% <sup>86</sup>, in another, it was 43.5% <sup>87</sup> . In addition, the latter study concluded that the presence of GORD

enhances dental erosion considerably in the most compromised of CP quadriplegics individuals, increasing their risk of oral disease. Many studies present a considerable association between GORD and dental erosion in children with CP <sup>84,88</sup> .

This emphasizes the importance of recognizing GORD patients by dental professionals, and referring them to a gastroenterologist. Special attention should be paid to the important relationships between disabled people, caregivers, multidisciplinary teams, along with truthfulness during an oral examination <sup>89,90</sup> . The dental practitioner may be able to minimize erosion in CP patients through preventive measure, such as the application of a fluoridated solution <sup>91</sup> .

### *Vomiting*

Vomiting may be spontaneous or self-induced, and perhaps linked with a range of medical problems. In addition it must be noted that there has been an increase in the prevalence of eating disorders (bulimia nervosa and anorexia) <sup>84</sup> .

### *B. Extrinsic Acidic Sources*

That includes drinks, food, medication, life style and environmental factors <sup>80</sup>. Frequency of, instead of total intake of drinks, may be critical in the erosive process. Titratable acidity and the pH of the drink are significant in assessing a drink's erosive potential. The erosive potential of chewable vitamin C tablets and iron preparations was highlighted in an early report by Giunta, *et al.* Such supplements are not widely used among children and adults <sup>92</sup>. There have also been changes in general habits and lifestyle, including the significance of eating healthy food including five pieces of fresh fruit or vegetables per day, which has been stressed by national campaigns. Further, there has been an increase in the number of individuals who are vegetarian, who are hence exposed to a more acidic diet. The acquired habit of frothing carbonated beverages in the mouth,

and frequent and excessive consumption of acidic sport drinks (as part of regular healthy exercise) further adds to acidic intake <sup>84</sup>. Dentists should be alert that there are cultural differences among patients and should question them about any habits that may increase the risk of tooth wear.

### *C. Environmental factors*

Environmental motives, such a contact with acids as part of work or leisurely activity may lead to erosion of the tooth. Though there have been reports of dental erosion in battery workers, sheet metal workers, laboratory technicians, professional wine tasters, and competitive swimmers, environmental factors contributing to tooth erosion are generally uncommon <sup>93-95</sup>.

### *E. Bruxism*

Bruxism is defined as a movement disorder of the masticatory system that is characterized by, among others, teeth grinding and clenching during sleep and wakefulness <sup>96,97</sup>.

The aetiology of this parafunctional activity is multifactorial, and may include spasticity<sup>98</sup>, unbalanced oral myofunctional disturbances <sup>14,99</sup>, dysfunction of the backbone with the head projected forward <sup>100</sup>, malocclusion <sup>101</sup>, sleep disorders <sup>102</sup>, or lack of control of the mandibular posture <sup>64</sup>. Many of the aforementioned conditions are common in children with CP <sup>99</sup>.

The prevalence of bruxism ranges from 25.0% to 69.4% amongst children with developmental disabilities such as CP <sup>99,103,104</sup>. While a higher prevalence rate has been reported in CP children<sup>105</sup>, other studies have found no significant differences between groups <sup>106</sup>. Bruxism in CP patients has been associated with athetosis <sup>107</sup>, spastic quadriplegia, sucking habits, posterior crossbite <sup>108</sup>, gastroesophageal reflux <sup>106</sup>, and Level III of the Gross Motor Functional Classification System <sup>109</sup>. Bruxism, as well as dental caries, have negative influences on the quality of life in this group of

individuals <sup>110</sup>. GORD, involuntary movements, and male gender were reported to be associated to bruxism in children with developmental disabilities <sup>110</sup>.

#### *F. Traumatic Dental Injuries Among CP Patients*

Incidence of dental trauma among CP populations was found to be as high as 57% in one study<sup>111</sup>, while other studies have reported prevalence rates between 9.2% and 20% <sup>108,112,113</sup>. One study suggests that the prevalence of dental trauma among CP patients attending rehabilitation centres was similar to that of non-disabled individuals who receive less treatment <sup>113</sup>.

Certain factors predispose CP populations to dental trauma such as high prevalence of class II malocclusion with prominent maxillary incisors, incompetent lips, struggles in ambulation, and increased incidence of seizures <sup>3</sup>. The most common type of injuries was fractures of enamel and dentine <sup>3,114,115</sup>.

#### *G. Enamel Defects Among CP Patients*

Enamel defects may be defects of enamel matrix formation, mineralization, or maturation with reduced or changed amounts of enamel formed by insult to the ameloblast cells <sup>116</sup>.

Metabolism of the ameloblasts is disturbed by systemic, local environmental stresses, genetic factors, or a combination of these, resulting in tooth defects. Therefore, the tooth enamel frequently acts as a depository of information on systemic insults, which are received during development. Such effects may begin before or after birth; consequently deciduous, permanent, or both teeth may be involved <sup>114</sup>.

In one study a high prevalence of developmental enamel defects among CP children was reported. The prevalence of defects varied with the tooth type, and were associated with gestational age of the children. Moreover, most of enamel defects were located symmetrically in the primary incisors and first molars in the upper jaw <sup>117</sup> .

#### *H. Temporomandibular joint (TMJ) problems*

There is an increased incidence rate of TMJ problems among CP populations, comprising of tenderness upon palpation, pain on opening/chewing, limited or diverged mandibular movement, crepitation, and luxation of the condyle, and hearing problems. However, there are fewer TMJ symptoms in CP individuals who have normal occlusion (no class II) <sup>115</sup>. Further, the hazard indicators for signs and symptoms of temporomandibular disorders are the existence of CP, severity of the malocclusion, male gender, mouth breathing and mixed dentition; children with CP had a significantly greater chance of developing these signs and symptoms <sup>118</sup> .



## **1.2 Aim**

The aim of this study was to assess the oral health status among children with CP compared with control subjects in Dubai, UAE. There is little information on the status of oral health and the dental treatment needs of CP children in Dubai, UAE. This data is important in the development of interventions to improve the oral health of this group of special needs children.

## 2. Materials and Methods

### 2.1 Study Design, Location and Population

A quantitative case-control study design was used to compare oral health characteristics of CP children with that healthy control in Dubai. The study group consisted of CP individuals from special needs centres located in Dubai. The controls were healthy children from both governmental and private schools, located in the same geographic region as the special needs centres in Dubai. The controls were matched to the CP group in both age and gender. The calculation of the sample size is explained in the below section.

#### 2.1.1 Sample Size

The sample size calculation based on Cochran Equation of sample size using the formula:

$$B = 1.96 \frac{s}{\sqrt{n}}$$
$$N = \frac{(1.96)^2 s^2}{B^2}$$

B = width of 95% confidence interval and S is standard error of the mean estimation

Our calculation depended on the prevalence of caries among CP among a comparable community in the region. Using the data reported in a previous study of CP in the UAE,<sup>119</sup> the following data was available:

The estimation was  $13.2 \pm 0.84$ , where the s was 0.84

$$B = 1.96 * 0.84 / \text{Square Root } (60) = 0.2$$

$$N = (1.96 * 1.96) * (0.84 * 0.84) / (0.2 * 0.2) = 68$$

A 20% expected non-response rate was added to the sample size, and calculated to yield the working sample size of 82. The total sample size projected was 82 Cerebral Palsy and 82 healthy children.

### 2.1.2 Sampling Technique

#### 1. CP group:

For this group, a census-sampling technique was used. All CP children registered in the special needs centres in Dubai were invited to participate in the study.

#### 2. Control group:

For this group, a stratified random sampling technique was used. This was done through random selection of every 4<sup>th</sup> student from schools located nearby the special needs centres. With regard to age, for each CP age group, a matching grade in the school was chosen which had similar age ranges. In addition, the number of females and males were matched between the CP group and the control within each age group.

### 2.1.3 Participating Special Needs Centres and Schools

#### 1. Special needs centres in Dubai:

An approval letter was obtained from the Ministry of Social Affairs in Dubai to access children with CP in special need centres located in Dubai (Appendix I). All special needs centres in the Emirate agreed to participate in the study save for Dubai Centre for Special Needs, where the principal declined to take part. The following centres agreed to participate in the study:

- Al Noor Training Centre for Children with Special Needs
- Rashid Centre for Disabled
- Dubai Rehabilitation Centre

#### 2. Public/private schools in Dubai:

An approval letter was obtained from the Ministry of Health in Dubai to access the control group in public and private schools in Dubai (Appendix II). The following schools agreed to participate in the study:

- Jumeirah Model Girls School
- Zayed Bin Sultan School
- Al Maaref Private School

## **2.2 Inclusion and Exclusion Criteria**

### **2.2.1 Inclusion Criteria**

#### **1. CP Group:**

- CP patients age 4 to 18 were invited to participate;
- Both UAE and non-UAE nationals were eligible to participate;
- All children previously diagnosed with CP according to the centre's medical records;
- Consent was obtained from parents or legal guardians for both CP and control groups (Appendices IV, V and VI, VII);
- Approval to access the centres and schools was obtained from the headmasters.

#### **2. Control Group:**

- Healthy with no known disease;
- Children were matched to the CP group in age and sex.

### **2.2.2 Exclusion Criteria**

Uncooperative CP children and healthy non-CP who were difficult to examine were excluded.

## 2.3 Data Collection

Data was collected using standard form (Appendix VIII) through dental examination. The examination was conducted by two principal investigators, and an assistant recorded the findings in the data sheet. Initially the data sheet was identifiable by the child's name. Once the data sheet was checked for completeness, the sheets were coded.

### 2.3.1 Examiners Calibration

A pilot study was conducted before the data collection. The two examiners were trained and calibrated to use the basic WHO Oral Health survey methods<sup>120</sup> by Dr Mawlood Kowash, Associate Professor in Hamdan Bin Mohamed College of Dental Medicine, who was also calibrated for all the indices used in this research. Intra- and inter-examiner reliability was calculated using Kappa statistics prior to starting the data collection. The results were as follow:

- Intra Kappa: There was matching between before and after reading ( $X^2(1, P=0.317)$ ).
- Inter Kappa (McNemar's test): There was matching between the two examiners' reading (Kappa= 0.029,  $P=0.606$ ).

### 2.3.2 Dental Examination

The dental exam was performed on a portable dental chair (Figure 1) at the centre/school nurse's room. One student at a time was examined using sterile gloves, artificial light, disposable mouth mirror and a WHO ball ended dental probe <sup>121</sup>. The probe was only used to remove debris and not to probe any fissures <sup>120</sup>.



Figure 1: Portable dental chair used to examine the children.

### 2.3.3 Cross Infection Control

National Institute for Clinical Excellence (NICE) guidelines<sup>122</sup> were followed for cross infection measures during the examinations:

- Hands were decontaminated immediately before and after examining each patient using alcohol hand rubs or hand washing;
- Alcohol hand rubs were used preferably, while liquid soap and water were used if the hands were visibly soiled with body fluids;
- Gloves were used as a single use items for each candidate since there was contact with oral mucosal surfaces and saliva. Gloves were worn immediately before patient contact and removed after completing the examination;
- Alternative to natural rubber latex gloves were available for patients with history of latex allergy;
- Gloves were discarded immediately by the examiner into waste disposable bags;
- All instruments were disposable. The gloves were discarded immediately by the examiner into waste disposable bags. Sharp instruments were placed in the sharp container.



### 2.3.4 Indices

The following indices were used:

1. Angle malocclusion classification and primary molar terminal plane relationship.

These were used to record the various molar relationships in each individual. For the permanent dentition, the classification is based on where the buccal groove of the mandibular first molar contacts the mesiobuccal cusp of the maxillary first molar: on the cusp (Class I, normal occlusion); distal to the cusp (Class II); or mesial to the cusp (Class III) <sup>123</sup>. However, the primary molars are classified as flush terminal plane, distal step or mesial step according to the relationship of the distal surfaces of the opposing primary second molars to each other <sup>124</sup>.

2. Caries Index: dmft/DMFT

This index was used to examine the dentition status of the child. Both primary and permanent teeth were examined and given a specific code as in D (decayed), M (missing) and F (filled). The WHO criteria was followed in order to correctly record the findings <sup>120</sup>. Met Need Index (MNI), an indication of treatment received by an individual is determined using the ratio of the mean missing (M) plus filled (F) teeth to mean decayed, missing and filled teeth (DMF); that is  $M+F/DMF$ . While Restorative Index (RI) – which reflects the restorative care of those who have suffered the disease – is measured by the ratio of filled (F) to filled plus decayed teeth (F+D) percent; that is  $F/F+D$  percent (%), as described by Jackson <sup>125</sup>.

### 3. Simplified Oral Hygiene Index of Greene and Vermillion

This index is a combination of debris index (i.e. plaque and calculus). For permanent dentition six Index teeth were examined (buccal and lingual surfaces of each) and scored according to specific criteria from 0 to 3. The scores ranges from zero, which is absence of debris, to 3, which is debris covering more than two thirds of the examined tooth surface <sup>126</sup>. For primary dentition, a separate record was done where the presence of gingivitis, calculus, and debris were marked as either present or absent.

### 4. Erosion Index

Erosion was measured using the erosion index, modified by Walker, et al <sup>127</sup>. With regard to permanent dentition, both labial and palatal surfaces of the upper incisors and occlusal surfaces of the first permanent molars were assessed. However, in the primary dentition, only the primary incisors were assessed. The highest score from the below list is marked (Table 1):

Table 1: Erosion Index

Code	Depth	Area of surface affected
0	Normal	normal
1	Enamel only	Less than 1/3 of surface involved
2	Enamel and dentine	1/3 up to 2/3 of surface involved
3	Enamel dentine and pulp	2/3 or more of surface involved
9	Assessment cannot be made	Assessment cannot be made

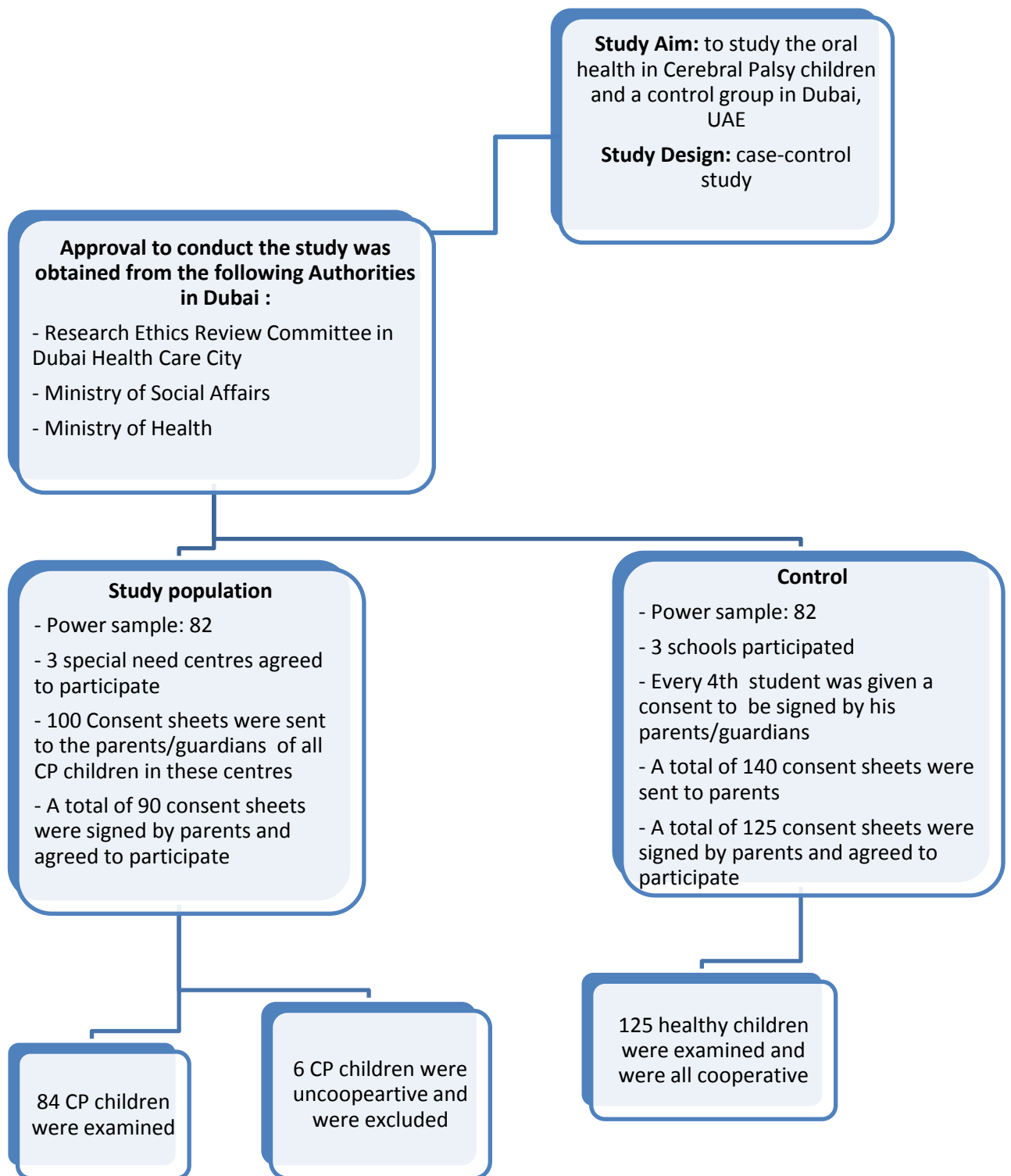


Figure 2: Study methodology summary flowchart.

## 2.4 Statistical Analysis

Data was entered into a computer, using SPSS for Windows, software version 20.0 (SPSS Inc., Chicago, IL). Numerical data was tested to normality using the Kolmogorov-Smirnov test, which is valid for large sample size. A cross-tabulation was used to examine the independency between categorical variables, and statistical analysis was performed using  $\chi^2$ -square and Exact Fischer tests, where appropriate, in order to test the association. Where two or more continuous independent variables were examined, t-test and analyses of variance were used if the measurements were normally distributed. In case of non-normality of measurements, the Mann-Whitney and Kruskal Wallis test of continuous data were used. P-value of less than 0.05 was considered significant in all statistical analysis.

## 2.5 Ethical Considerations

This study was conducted in full conformance with principles of the “Declaration of Helsinki,” Good Clinical Practice (GCP), and within the laws and regulations of the UAE/DHCC. Ethical approval was obtained from the Research Ethics Review Committee in Dubai Healthcare City (Appendix III).

## 3.Results

### 3.1 Study Sample Characteristics

The characteristics of the 84 children with Cerebral Palsy (CP) and the 125 healthy controls are shown in Table 2. Demographical data about their nationality; gender, dentition and age are described.

Children with CP had an average age of ( $9.33 \pm 3.89$ ), where the control group had an average age ( $9.30 \pm 2.68$ ). For gender distribution, 51 (60.7%) of children with CP were males compared to 33 (39.3%) female. Non-local CP (non -UAE) children were greater in number than local children in the study sample, with 48 (57.1%) and 36 (42.9%) respectively. This difference was statistically significant with a p-value  $< 0.001$ .

The age, gender, and dentition distribution were comparable between children with CP and the healthy controls (Table 2).

Table 2: Demographic characteristics and type of dentition among children with CP and healthy subjects

Items	Categories	Control Nr (%)	CP Nr (%)	Total Nr (%)
Number		125	84	209
Nationality	Local	85(68)	36(42.9)	121(57.9)
	Non-local	40(32)	48(57.1)	88(42.1)
Gender	Male	55(44)	51(60.7)	106(50.7)
	Female	70(56)	33(39.3)	103(49.3)
dentition	Primary	13(10.4)	23(27.4)	36(17.2)
	Permanent	36(28.8)	27(32.1)	34(40.5)
	Mixed	76(60.8)	34(40.5)	110(52.6)
Age	Average (SD)	9.30(2.68)	9.33(3.89)	9.31(3.20)

## 3.2 Dental Caries

### *Prevalence*

The overall prevalence of dental caries among children with CP was 53% (44/84) while the healthy controls had a prevalence of 57.6% (72/125). The prevalence of caries in the primary teeth among children with CP was 58.9% (33/56) while for the healthy control it was 70.5% (62/88). In the same context, the prevalence of caries in the permanent teeth among children with CP was 25.4% (16/63) while for the healthy controls it was 17.9% (20/112) as shown in Figure 3.

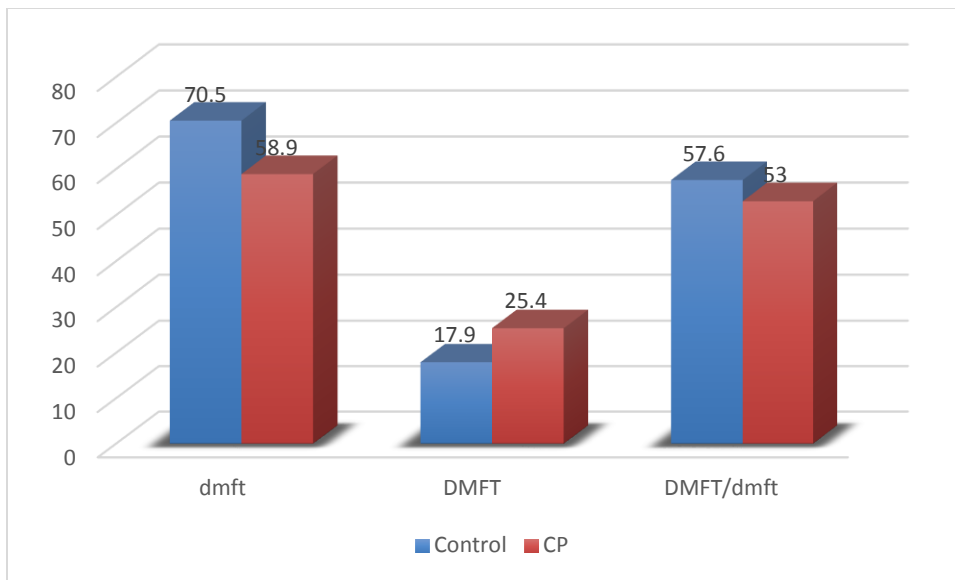


Figure 3: Prevalence of caries in CP and control groups.

### *DMFT/dmft Caries Index*

Tables 3 and 4 demonstrate the caries status of the sample population. The mean number of the decayed component of DMFT in CP children was ( $2.19 \pm 3.21$ ) whereas in the healthy children it was ( $1.65 \pm 2.46$ ),  $p$  value = 0.613. There was no statistically significant difference in caries experience amongst CP children compared to the healthy controls as measured by DMFT/dmft in all age groups as shown in Tables 3 and 4. The mean number of DMFT in CP children was comparable to that in healthy children ( $2.83 \pm 2.86$  vs  $2.16 \pm 2.86$ ,  $p$  value = 0.180). The dmft scores were comparable in CP patients with primary dentition as compared to their controls ( $4.04 \pm 5.46$  vs  $2.69 \pm 3.00$ ,  $p$  value = 0.415).

In regards to the treatment of decayed teeth (fillings), children in the control group received greater treatment than their CP counterparts in all age groups; however, this was not shown to be at a statistically significant level.

The restorative care and the treatment received in both study groups and control groups were represented by the Restorative Index (RI) and the Met Need index (MNI) in Tables 3 ,4, 5 and 6. Looking at different age and dentition groups, CP children in the mixed dentition group had the lowest RI and MNI scores compared to permanent and primary dentition as shown in Tables 4, 5 and 6.

Table 3: Caries status (DMFT), Restorative Index and Met Treatment Index in CP and control children (Mean values in both permanent and mixed dentition)

	Controls	CP	
	n = 125	n = 84	p-value
DMFT index	2.16 ± 2.89	2.83 ± 2.86	0.180
Decay	1.65 ± 2.46	2.19 ± 3.21	0.613
Missing	0.29 ± 0.83	0.48 ± 1.62	0.308
Carious	1.65 ± 2.46	2.19 ± 3.21	0.192
Filled	0.22 ± 0.61	0.53 ± 2.04	0.143
Restorative Index (RI)	4.7	1.9	-
Met Need Index (MNI)	0.24	0.32	-

(RI) Restorative Index =F/F+D

(MNI) Met Need Index =M+F/DMF



Table 4: Primary dentition caries status, Restorative Index and Met Treatment Index among children in both healthy and CP groups

Primary dentition	Control	CP	p-value
	n = 13	n = 24	
dmft index	2.69±3.00	4.04±5.46	0.415
decayed	2.69±3.00	4.04±5.46	0.897
missing	0±0	1.13±3.65	0.391
filled	0.08±2.28	0.09±0.29	0.974
Restorative Index (RI)	0.03	0.02	----
Met Need Index (MNI)	0.03	0.23	

(RI) Restorative Index =  $F/F+D$

(MNI) Met Need Index =  $M+F/DMF$

Table 5: Mixed dentition caries status, Restorative Index and Met Treatment Index among Children and adolescents in both healthy and CP groups

Mixed dentition	Control	CP
	n = 76	n = 33
dmft index	2.77±2.94	2.5±3.16
decayed	2.77±2.94	2.5±3.16
missing	0.47±1.03	0.50±1.02
filled	0.31±0.73	0.13±0.42
Restorative Index (RI)	0.10	0.05
Met Need Index (MNI)	0.22	0.20
DMFT	0.22±.58	0.24±0.79
Decayed	0.22±.58	0.24±0.79
Missing	0	0
Filled	0.02±0.16	0.0
Restorative Index (RI)	0.08	0
Met Need Index (MNI)	0.08	0

(RI) Restorative Index =F/F+D

(MNI) Met Need Index =M+F/DMF

Table 6: Permanent dentition caries status, Restorative Index and Met Treatment Index among Children and adolescents in both healthy and CP groups

permanent dentition	Control	CP
	n =36	n =27
DMFT	0.28 ± 0.61	1.89 ±3
Decayed	0.28±0.61	1.89 ±3
Missing	0	0.04±0.19
Filled	0.06± 0.23	0.19±0.79
Restorative Index (RI)	0.18	0.09
Met Need Index (MNI)	0.18	0.11

(RI) Restorative Index = $F/F+D$

(MNI) Met Need Index = $M+F/DMF$

### 3.3 Oral Hygiene Status

Oral Hygiene Index Score (OHI-S) was calculated for children in the mixed and permanent dentition groups, with no significant difference found between CP children compared with controls ( $1.68 \pm 1.34$  vs  $1.42 \pm 1.14$ ). Calculus Index was found to be significantly higher among children with CP  $0.56 \pm 0.78$  compared with controls  $0.07 \pm 0.27$  (p-value < 0.001). On the other hand, the proportion of debris was significantly lower among children with CP at 57 (69.5%), compared with 110 (88%) in the healthy controls, p-value was 0.001. Conversely, calculus proportion was significantly higher among children with CP at 33 (40.2%) compared with that of healthy controls at 10 (8%) with p-value < 0.001. The proportion of gingivitis was found to be comparable between children with CP and the control group, at 58.8% and 70.4% respectively (p-value = 0.076). These results are summarized in Table 7, and the percentage distributions of debris, calculus, and gingivitis in children with CP and controls are summarized in Figure 4.

Table 7: Oral hygiene status in CP children and control

Index	Control		CP	P-value
	Nr	SD $\pm$	$\pm$ SD	
Debris-index	111/60	1.38(1.08)	1.10(0.83)	0.086
Calculus-index	111/60	0.07(0.27)	0.56(0.78)	0.001
Oral-Hygiene-index	111/60	1.42(1.14)	1.68(1.34)	0.193

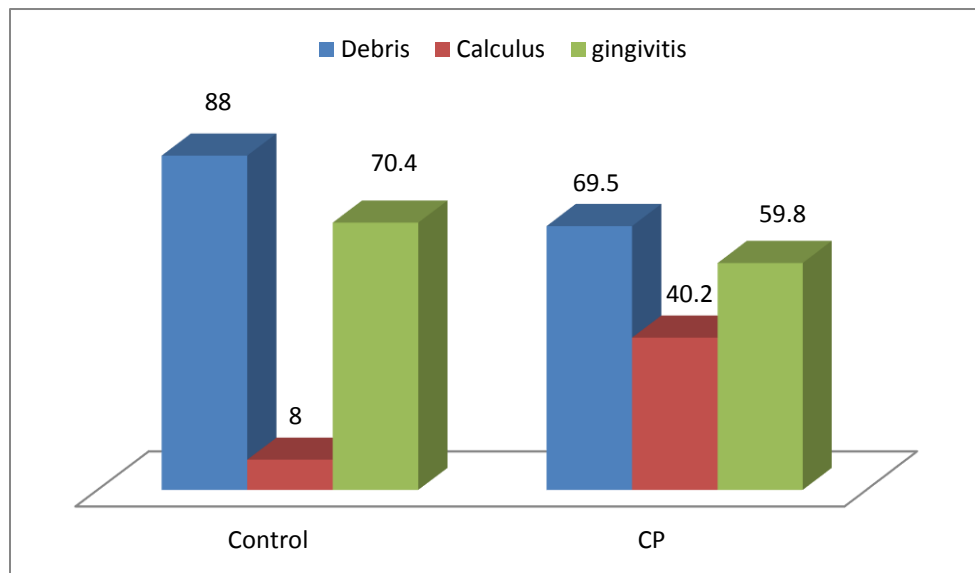


Figure 4: Percentage distribution of debris, calculus and gingivitis in children with CP and control.

### 3.4 Occlusal Anomalies and Traumatic Dental Injuries

Regarding permanent molar angle classifications, the proportion of class I was more frequent among healthy controls 68 (61.8%) compared with children with CP 8 (14%). Conversely, the proportion of class (II) was higher among children with CP 46 (80.7%) compared with healthy controls 28 (25.5%). Lastly, the proportion of class (III) was found higher among healthy controls 14 (12.7%) compared with children with CP 3 (5.3%) (p-value is less than 0.001).

Primary molar relationships in CP individuals presented lower occurrences of mesial step (37.5%) compared to healthy control children (62.5%). However, the distal step relationship was only present in CP children (100%) compared to the control group (0%). The flush terminal plane relationship was higher in the CP group (64.4%) compared to the control group (35.7%). The distribution of permanent molar Angle malocclusions and primary molar occlusions in CP and control groups are shown in Figures 5 and 6, respectively.

Anterior open bite was significantly higher among children with CP 24 (29.3%) compared with healthy control, 14 (11.2%) (p-value= 0.001). There was no significant difference between the proportions of deep bite among children with CP compared to the proportion among healthy controls at 23.2% and 18.4% respectively. The proportions of posterior cross bite were not significantly different among children when comparing CP and healthy controls, with 20 (24.4%) and 35 (28%) respectively; for scissor's bite it was recorded at 3 (3.7%) and 3 (2.4%) for CP children and healthy controls respectively. In relation to spacing between teeth, it was found that the proportion of anterior spacing was significantly higher among children with CP 41 (50%) compared with that of the healthy controls 40 (32%), (p-value = 0.007). Conversely, the proportion of spacing posteriorly was comparable between children with CP and healthy controls, 7 (8.5%)

and 10 (8%) respectively. For crowding the data revealed that the proportion of posterior crowding was significantly lower among children with CP compared to healthy controls 4 (28.6%) and 10 (12.2%) respectively (p-value = 0.013). The proportion of anterior crowding among children with CP was comparable with that of healthy controls, 63 (76.8%) and 90 (72%) respectively. The proportion of trauma was found to be significantly higher among children with CP, at 26 (31.7%), compared with that of healthy controls, at 4 (3.2%), (p-value < 0.001).

Table 8 summarizes the results of occlusal anomalies and traumatic dental injuries in CP and control children. Examples of uncomplicated crown fractures and tooth discolouration in CP patients are shown in Figures 7 and 8 respectively.

The mean overjet between children with CP and of healthy controls were not significantly different. The mean were 2.8 (1.98) and 3.39 (2.2) respectively. The data had too small size of reverse overjet among the two groups to be statistically analysed.

Table 8: Occlusal anomalies and traumatic dental injuries in CP children and control

Anomalies	Control	CP	
	Nr (%)	Nr (%)	P-value
<b>Vertical</b>			
open bite	111(88.8)	58(70.7)	0.001
deep bite	102(81.6)	63(76.8)	0.254
<b>Transverse</b>			
Crossbite	90(72)	62(75)	0.341
scissor bite	122(97.6)	79(96.3)	0.448
<b>Spacing</b>			
anterior spacing	85(68)	41(50)	0.007
posterior spacing	115(92)	75(91.5)	0.542
<b>Crowding</b>			
anterior crowding	90(72)	63(76.8)	0.272
posterior crowding	121(96.8)	72(87.8)	0.013
<b>Trauma</b>	121(96.8)	56(68.3)	0.001



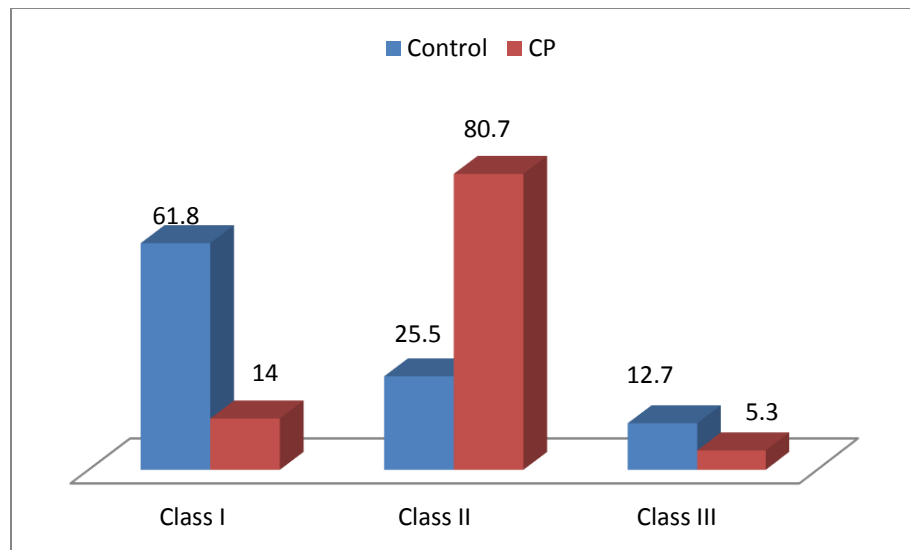


Figure 5: Distribution of permanent molar Angle malocclusion classification in CP and control.

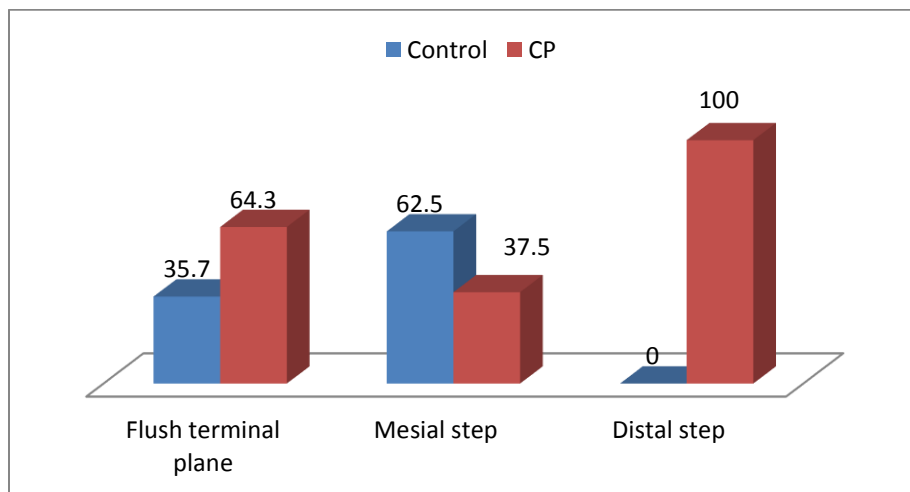


Figure 6: Distribution of primary molar classification in CP and control.



Figure 7: Trauma (uncomplicated crown fracture) of the upper right central incisor



Figure 8: Trauma to upper right central incisor with tooth discolouration

### 3.5 Dental and Hard Palate Anomalies

Children with CP demonstrated higher proportions of high arched palate at 79 (96.3%) vs 42 (33%) (p-value less than 0.001). The results of dental and hard palate anomalies in CP children and the controls are presented in Table 9.

Table 9: Dental and hard palate anomalies in CP children and control

Anomalies	Control	CP	
	Nr (%)	Nr (%)	P-value
Shovel shape incisors	0	0	
High arched palate	42(33.6)	79(96.3)	0.001
Microdontia	1(0.8)	0	0.607
Nipple appearance of canine	1(0.8)	1(1.2)	0.673

### 3.6 Oral Soft Tissues' Anomalies

As demonstrated in Table 10, children with CP had a significantly higher proportion of angular cheilitis 21 (25.6%), compared with zero in healthy controls, and higher proportion of macroglossia 49 (59.8%) compared with zero among healthy controls. Further, children with CP had higher proportions of drooling 72 (87.8%) compared with zero among healthy controls (it was measured by observing both the CP and healthy controls), tongue thrust 26 (31.7%) vs 2 (1.6%) respectively, and lymphadenopathy at 74 (90.2%) vs 5 (4%), respectively (p-value less than 0.001 for the above anomalies).

Table 10: Oral soft tissues findings in CP children and control

Condition	Control	CP	
	Nr (%)	Nr (%)	P-value
Atrophy of tongue	0	2(2.4)	0.156
Tongue thrust	2(1.6)	26(31.7)	0.001
Geographic tongue	0	2(2.4)	0.156
Fissure tongue	0	1(1.2)	0.396
Lymphadenopathy	5(4)	74(90.2)	0.001
Angular cheilitis	0	21(25.6)	0.001
Macroglossia	1(0.8)	49(59.8)	0.001
Gingival hyperplasia	0	1(1.2)	0.396
Trauma to soft tissue/lip	0	1(1.2)	0.396
Drooling	0	72(87.8)	0.001

### 3.7 Erosion

According to the pyramid graph (Figure 10), the severity of erosion was significantly higher among CP children compared to healthy controls (p-value < 0.001). The proportion of CP children with erosion was 42.7% vs 15.2% in the control group. While the percentage of CP children with erosion into enamel only was 24.4 % (20/84) compared to 11.2 % (14/125) in the control group, the percentage of erosion into enamel and dentine was 15.9% (13/84) in CP children vs 4% (5/125) in healthy children. Additionally, the percentage of severe erosion, extending into dentine and pulp, was 0% in the control group compared to 2% (2/84) in CP group.

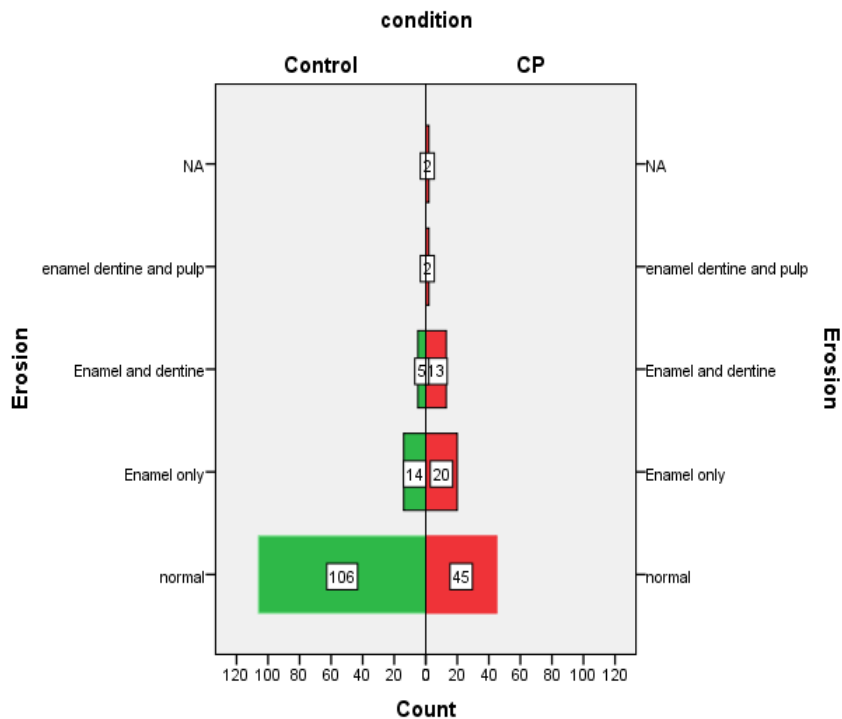


Figure 9: Erosion severity in CP children and control group

## 4. Discussion

Currently, the prevalence and incidence of cerebral palsy in children in the UAE has not been investigated. This in part due to the lack of CP registry data in the UAE in general, and in Dubai in particular. However, experts in the field indicate that the prevalence is similar to that of Western populations <sup>12</sup>. This study provided an opportunity to assess the oral health problems among children with CP in Dubai, who are currently enrolled in special needs centres.

The samples used in this study present fair distributions with respect to age and sex. Males (51 out of 84, 60.7%) of the CP group were more than females (33 out of 84, 39.3%), which may reflect the higher occurrence of CP in males, as reported by a study conducted in Sharjah city and other parts of the world <sup>119,128–130</sup>. With regard to geographical distribution, special needs centres were chosen from different areas of Dubai, the control group samples were matched accordingly.

The wide distribution of special needs centres and schools chosen allowed us to cover Dubai city as a whole, rather than merely focus on a particular area or areas of the city. A sample size calculation was conducted prior to data collection to ensure a sufficient number of children were included. This might have strengthened the validity of the results and made them applicable to neighbouring cities in the UAE. 84 CP individuals along with 125 controls were examined, exceeding the calculated power sample size. The non-local CP patients were found to be significantly greater than local Emirati patients in the study group,  $p\text{-value} < 0.001$ ; an interesting finding that could be attributed to a tendency of lower CP prevalence in Emirati populations

compared to expat populations. Alternatively, these results could be due to higher rate of enrolment of expat CP children in special needs schools compared to Emirati CP children.

#### 4.1 Dental Caries

The present study used the dmft/DMFT index to detect dental caries according to WHO criteria<sup>120</sup>. Numerous studies have shown that this method is efficient in detecting dental cavities, but not non-cavitated lesions<sup>97</sup>. The inclusion of non-cavitated lesions would give a better idea of disease prevalence, translating into a better understanding of treatment needs<sup>134</sup>, however, the dmft/DMFT index of cavitated lesions was used in this study due to its objectivity. Further, the WHO criteria of caries diagnosis is still the standard in epidemiological studies, and its use allows comparison of these study results with national and international studies. Moreover, using radiographs to detect non-cavitated lesions for screening purposes would be neither ethical nor practical.

In this study, the mean number of the decayed component of DMFT index in CP children was higher than that in healthy children, though this difference was not statistically significant ( $2.73 \pm 0.22$  vs  $1.65 \pm 2.46$ ,  $p$  value = 0.613). There was no statistically significant difference in caries experience between CP children and healthy controls as measured by DMFT/dmft in all age groups. The mean number of DMFT index in children with CP was comparable to that in healthy children ( $2.83 \pm 2.86$  vs  $2.16 \pm 2.86$ ,  $p$  value= 0.180). The dmft scores, however, were higher among the youngest age groups in CP with primary dentition compared to their controls, though this difference was also not found to be statistically significant ( $4.04 \pm 5.46$  vs  $2.69 \pm 3.00$ ,  $p$  value=0.415).

These findings are consistent with a previous study conducted in Sharjah<sup>119</sup>. In that study, the mean number of the decayed component of DMFT in CP patients was significantly higher than that in healthy controls ( $6.5 \pm 0.84$  vs  $5.0 \pm 3.15$ ,  $p$  value  $\leq 0.05$ ). In addition, Shaw, *et al.* reported dmft and DMFT values of 1.36 and 1.85, respectively, for children with disabilities<sup>135</sup>; Gizani, *et al.* reported a mean DMFT value of 2.9<sup>136</sup>; and Shyama, *et al.* reported a mean DMFT of 4.5 for children with CP<sup>137</sup>.

The prevalence of caries in CP children has varied in the literature and, with conflicting findings, ranging from lower, equal, and higher caries prevalence in among children with CP in comparison with populations of healthy children. The results of several studies were inconclusive as to whether children with CP have a higher caries rate than other children<sup>3</sup>. Nevertheless, some studies found that subjects with CP had higher caries as they got older (represented by mixed and permanent dentition)<sup>68</sup>. Further, the incidence of dental caries in children and adolescents with CP was high, and associated with the subject's sociodemographic, behavioural, and clinical characteristics<sup>69</sup>. Dury, *et al.* found that all children, regardless of being affected with CP, had similar caries experiences<sup>23</sup>. In a 1991 study conducted, the prevalence of caries was reported to be lower among children with CP compared to healthy controls<sup>138</sup>. This was consistent with the present study findings, where the prevalence of caries was found to be lower in CP children compared to healthy



controls. The prevalence of dental caries among children with CP was 53% (44/84) while the healthy controls had a prevalence of 57.6% (72/125). A high caries rate among healthy control children in Dubai is not surprising as it seems to follow the normal caries pattern reported by a dental survey conducted among healthy children in the UAE, which found that the prevalence of dental caries among healthy school children was 76.1% and the average dmfs score was 10.2 <sup>139</sup>. This high prevalence of dental caries in the UAE may be attributed to cultural factors <sup>140</sup>, such as strong family cohesion, and the involvement of extended family members in taking care of children, along with high sugar diets and lack of dental visits <sup>141</sup>.

The Met Need Index (MNI) is an indication of treatment received by an individual, while the Restorative Index (RI) reflects the restorative care of those who have suffered oral disease <sup>142</sup>. Among the studied, CP children were low compared with healthy control subjects in mixed and permanent dentition. These values were consistent with the results found in Sharjah <sup>119</sup> as well as those in other countries <sup>143</sup>. These results indicate the higher need of dental services for this unique group of patients, with a high prevalence of dental caries compared with healthy patients. Consequently, the preventive and restorative treatment needs of many CP children in the present study were unmet. However, in primary dentition, MNI was higher in CP children compared with healthy control subjects. A possible explanation for this could be the fact that most children in this younger age group may have had the extractions of the teeth, rather than have fillings performed under general anaesthesia due to their special medical condition, and difficulty coping with regular dental treatment.

Possible related factors to the above may include insufficient funding and resources, insufficiently trained dentists to treat patients with special needs, and complex treatment needs requiring special care or general anaesthesia <sup>144</sup>. Consequently, only emergency treatment may be sought when individuals experience dental pain; in many instances this lead to extraction of the involved primary tooth. Kakaounaki has shown that 82% of dental interventions in children with disabilities are extractions <sup>145</sup>, and MacPherson reports that 96% of extractions are performed under general anaesthesia <sup>146</sup>.

However, our inability to recruit CP children who are not presently enrolled in the special needs centres may bias these findings, as we are not aware of their dental health status and treatment needs.

## **4.2 Oral Hygiene Status**

Periodontal disease and poor oral hygiene represent significant problems for special needs children. The findings of this study show that the proportion of debris was significantly lower among children with CP 57(69.5%) compared with 110 (88%) in the healthy controls, (p-value = 0.001). The CP groups attended special needs centres, and, as part of these centres' usual routine, caregivers either supervise or carry out tooth brushing for the children. This may have contributed to the lower debris index measured in the study group.

On the other hand, the Calculus Index was found to be significantly higher among children with CP ( $0.56 \pm 0.78$ ) compared with healthy controls ( $0.07 \pm 0.27$ ) (p-value < 0.001). The higher calculus in CP patients may be attributed to the high calcium content in their saliva <sup>147</sup> .

The proportions of gingivitis between children with CP and the healthy group enrolled in this study were comparable at 59.8% and 70.4% respectively (p-value of 0.076). Gingivitis was present in more than half of the CP sample, though this was less than in the control group. Gingival health in CP is often reported to be poor, due to difficulties in maintaining oral hygiene as a result of poor neuromuscular control and/or other health priorities <sup>14,71</sup> . In addition gingivitis may arise as a result of food pouching and mouth breathing, especially in the anterior region in individuals with CP<sup>1</sup>.

Due to challenges with patient cooperation in the study group, and the limited time available for performing the examination, our study did not measure any parameter for periodontal disease such as the Basic Periodontal Examination (BPE).

In one study, children with CP had greater prevalence of periodontal disease in primary dentition than children in the control group<sup>71</sup>. However, other studies report that the prevalence of periodontal disease in CP children is similar to that of healthy children <sup>26</sup>. Further, periodontal disease was reported to be common, particularly in older children with CP due to poor oral hygiene, problems of oral habits, physical disabilities, malocclusion and gingival hyperplasia caused by medications for people with cerebral palsy <sup>24</sup>, along with mouth breathing and a papillary hyperplastic gingivitis seen even in the absence of phenytoin <sup>26</sup> .

There is an increasing need for comprehensive preventive dental programs in order to promote better oral hygiene, and prevent the development and progression of periodontal diseases. The hallmark of managing these children's oral health is prevention.

### 4.3 Occlusal Anomalies

Malocclusion plays a significant part in the overall oral health of an individual as it is linked with TMD, periodontal disease, and may be complicated by an individual's disability<sup>72-74</sup>. Risk for malocclusion can originate from physical, behavioural, or disease factors<sup>75,76</sup>.

The prevalence of malocclusion was found to be higher in individuals with disabilities than in controls without disabilities; in addition, malocclusion was more common when the special need was mental rather than physical in origin<sup>77</sup>.

In the present study, CP subjects had significantly higher proportion of anterior open bite (29.3% vs 11.2%) (p-value = 0.001). This was consistent with a study which conducted by Carmagnani, *et al.* which reported that anterior open bites were significant in CP patients with double hemiplegia (64 %)<sup>148</sup>. The proportion of posterior cross bite and scissor bite were not significantly different when comparing CP and healthy controls; (24.4%) and (28%) (p value = 0.341) for posterior cross bite, and (3.7%) and (2.4%) (p value = 0.448) for scissor bite, respectively. In relation to spacing between teeth, it was found that the proportion of anterior spacing was significantly higher among children with CP (50%) compared with that of the healthy controls (32%) (p-value = 0.007).

For crowding the data revealed that the proportion of posterior crowding was significantly lower among children with CP (28.6%) compared to healthy controls respectively (12.2%) (p-value =

0.01). Further, the proportion of anterior crowding among children with CP was higher but not statistically significant than that of healthy controls at 76.8% and 72% respectively (p-value = 0.272). These findings were confirmed by another study, in which Folakemi, *et al.* found that crowding and spacing of the anterior segment was more prevalent in CP group compared to healthy control at 18.8% and 17.4%, respectively <sup>149</sup>.

In this study, the proportion of trauma was found to be significantly higher among children with CP (31.7%) compared with that of healthy controls (3.2%) with p-value less than 0.001. This is due to certain factors which predispose CP population to dental trauma which have been previously mentioned, including: high prevalence of class II malocclusion with prominent maxillary incisors, incompetent lips, struggle in ambulation, and increased incidence of seizures <sup>3</sup>. The most common type of traumatic dental injuries CP patients suffer are fractures of enamel and dentine <sup>3,114,115</sup>.

Incidence of dental trauma among CP population was found to be as high as 57% in one study<sup>111</sup>. While other studies indicate a prevalence rate of dental trauma in such cases ranges from 9.2% to 20% <sup>108,112,113</sup>. Further studies suggest that the prevalence of dental trauma among CP patients attending rehabilitation centres was similar to non-disabled individuals who accessed less treatment <sup>113</sup>.

It is well established that Class II malocclusion is more common in CP children due to hypotonia of the orofacial musculature and forward thrust of the tongue <sup>13,14</sup>. Further, this type of malocclusion predisposes the individual to trauma of the anterior teeth, in addition to poor gait and seizures <sup>3</sup>.

This typical malocclusion was confirmed in our study, where CP subjects had significantly higher Class II malocclusions (80.7%) compared to controls (25.5%) with p-value less than 0.001. Additionally, the primary molar relationship in CP individuals was found to have higher

occurrence of distal step relationship when compared to that of the control group (100% vs 0%). This distal step relationship explains Class II malocclusions in older CP children, as distal step relationships may progress to Class II during the molar transition with continued mandibular growth<sup>150</sup>.

#### **4.4 Dentofacial Anomalies**

In this study, CP individuals, compared to controls, had remarkably high frequencies of high arched palate (96.3% vs 33%), tongue thrust (31.7% vs 1.6%) and lymphadenopathy (90.2% vs 5(4%). These findings were reported in the literature, along with other findings such as microdontia ,and retained deciduous teeth<sup>119,151</sup>.

#### **4.5 Oral Soft Tissues**

The CP sample in this study had significantly higher proportions of macroglossia (59 %), angular cheilitis (25.6%) and drooling (87.8%) compared to healthy controls with p value less than 0.001. Drooling was found in 87.8% of CP children in this study, which it has been reported in several studies that drooling affects up to 58% of children with cerebral palsy<sup>152,153</sup>. Drooling may be severe enough to interfere with daily social and practical functions<sup>152,154</sup>, and is due to impaired swallowing, and poor control of the orofacial musculature; it is not caused by hyper-salivation<sup>155,156</sup>. Drooling may be aggravated by malocclusion, postural problems, dental caries, and an inability to recognise salivary spill<sup>157</sup>.

## 4.6 Erosion

Dental erosion is a multifactorial condition which occurs due to the interaction of chemical, biological, and behavioural factors <sup>158</sup>. In this study, the severity of erosion was significantly higher among CP children compared to healthy control (p-value<. 001). The proportion children with CP suffering from dental erosion was 42.7%, vs 15.2% in the control group.

The prevalence of GORD in CP children was shown to be 53% in a previous study <sup>86</sup>. while it has been reported to be 43.5% in another study <sup>87</sup>. In addition, the latter study concluded that the presence of GORD enhances dental erosion considerably in the most compromised CP quadriplegics individuals, increasing their risk of oral disease. Many studies present a high association between GORD and dental erosion in children with CP <sup>84,88</sup>.

This emphasizes the important role of the dental professional in diagnosing GORD, and referring them to a gastroenterologist. Special attention should be paid to the important relationships between individuals with special needs, caregivers, a multidisciplinary team, along with truthfulness during oral examination <sup>89,90</sup>. The dental practitioner may be able to minimize erosion in CP patients through preventive measures, such as application of a fluoridated solution <sup>91</sup>.

Erosion is often associated with other forms of tooth wear, which refers to the three conditions of erosion, attrition, and abrasion <sup>159</sup>. This triad makes the diagnosis of dental erosion more difficult, as such, careful history taking is important <sup>160</sup>. The prevalence of tooth wear in primary teeth in Abu Dhabi children, a nearby city and the capital of UAE, was recently found to be very high, at 97% <sup>161</sup>. This high prevalence, if applicable to the city of Dubai, may have played a

role in the high prevalence of erosion found in the present study of CP patients.

#### **4.7 Study limitations**

As with every study, perfection is desired, however, there are obstacles and challenges at the time of conducting a study. Pointing out study limitations is good practice, and helps in understanding the overall outcome, as well as allowing for one to realize improved methods which may help overcome these challenges in future research. The limitations in this current study are as follows:

- As mentioned previously, there is no central CP registry data in the United Arab Emirates, hence only CP children in special needs schools and centres were invited to participate in the study. CP children who are raised at home are hence out of reach and cannot be tracked. This may have affected results;
- The study population was all from Dubai city. It would have been beneficial if CP children from all around UAE were able to participate, however, this was unachievable due to limits in time, number of researchers examining the children, and facilities to accommodate such a large number of participants;
- Our study did not measure any parameter for periodontal disease such as the Basic Periodontal Examination due to challenges with patient cooperation in the study group, and the limited time available for performing the examination.





### 3. Conclusions and Recommendations

- This current study had concluded that CP children in Dubai have a tendency for lower caries rate compared with healthy children;
- CP subjects received less restorations and dental treatment compared to the control in the mixed and permanent dentition groups, which suggest that the preventive and restorative treatment needs of many CP children in the present study were unmet;
- CP subjects have received less restorations and more dental treatment compared to the controls in the primary dentition, as demonstrated by the RI/MNI, which suggests that most of the children may have had teeth extracted, rather than have fillings performed under general anaesthesia;
- CP subjects had significantly more calculus than healthy children;
- CP subjects had significantly less oral debris than the control group;
- CP subjects had significantly higher proportions of anterior open bite, anterior spacing and trauma to anterior teeth. In addition, they demonstrated significantly higher Class II molar relationships compared to the controls;
- The dentofacial anomalies which were significantly higher in CP subjects were high arched palate, tongue thrust, and lymphadenopathy;
- Soft tissue findings in the CP group revealed significantly higher frequencies of angular cheilitis, macroglossia, and frequent drooling;
- The severity of erosion was significantly higher among CP subjects compared to healthy controls.

Looking at the outcome of this study, the following recommendations suggested for future research are:

- To present the findings of this study to the newly restructured Federal Ministry of Health and Community Prevention;
- To investigate the healthcare system provided for CP children, including general anaesthesia facilities, dental appointments, dental follow-ups, and waiting lists;
- To focus on parental/caregiver awareness programs, which stress the importance of oral health in special needs children;
- To establish improved prevention and community oral healthcare programs which target special needs children in Dubai;
- To suggest establishing a data registry for children with CP in the UAE. This will help in epidemiological studies and the provision of comprehensive oral healthcare for these children;
- To conduct a similar study to include all CP children in the UAE, in order to achieve a better understanding of their oral health and treatment needs.

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## **5. Appendix**

Appendix I: Letter of approval from the Ministry of Social Affairs – Dubai

Appendix II: Letter of approval from the Ministry of Health – Dubai

Appendix III: Ethical approval from the Research Ethics Review Committee in Dubai

Healthcare City, Dubai, UAE

Appendix IV, V, VI & VII: Study Consent sheets to be signed by parents/legal guardians

Appendix VIII: Data sheet

## Appendix I

UNITED ARAB EMIRATES  
MINISTRY OF SOCIAL AFFAIRS



الإمارات العربية المتحدة  
وزارة الشؤون الاجتماعية

التاريخ: 09/أبريل/2014  
المرجع: ر/ت/م/34/2014

المحترمين ،،،

السادة / مراكز المعاقين الحكومية والخاصة

تحية طيبة وبعد،،،

### الموضوع: دراسة حول صحة الفم والأسنان للأطفال الغير معاقين والأطفال المعاقين

تهديكم إدارة رعاية وتأهيل المعاقين أطيب التمنيات ، وبالإشارة إلى الموضوع أعلاه ، تقوم الطبيبتان بتول غيث وهيفاء الهاشمي بإجراء دراسة علمية للوقوف على مشاكل صحة الفم والأسنان التي تواجهها فئة المعاقين، من أجل وضع الحلول المناسبة من خلال برنامج طبي متكامل وتلبية احتياجاتهم العلاجية والوقائية وزيادة الوعي لدى الأهالي وتشجيعهم على العناية بصحة الفم والأسنان لأطفالهم .

يرجى التكرم بتسهيل المهمة للطبيبتين المذكورتين أعلاه، وتوفير كافة ما يحتاجن إليه من معلومات لتحقيق أهداف الدراسة المرجوة ، والارتقاء بالخدمات الطبية المقدمة للمعاقين في هذا المجال.

شاكرين لكم حسن تعاونكم الدائم معنا

وتفضلوا بقبول فائق الاحترام والتقدير ،،،

وفاء حمد بن سليمان

مدير إدارة رعاية وتأهيل المعاقين



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DUBAI • TEL: +971 4 263 7777 • FAX: +971 4 263 4882 • P.O. BOX 4409 • UNITED ARAB EMIRATES

## Appendix II

UNITED ARAB EMIRATES  
MINISTRY OF HEALTH

الإمارات العربية المتحدة  
وزارة الصحة

التاريخ: 2014/04/14م  
الرقم: 2014/64  
قسم المتابعة والتسيق

المسيد/ د. ديفيد راي  
المحترم  
عميد وپرفسور طب الفم - كلية دبي لطب الأسنان

تحية طيبة وبعد ..

الموضوع : الموافقة لإجراء دراسة  
حول صحة الفم والأسنان في المدارس الحكومية بأمانة دبي

تهديكم أطيب التمنيات ونتمنى لكم دوام التوفيق والتقدم.

كما أننا نشكر لكم سعيكم في إجراء دراسة للبحث عن مشاكل صحة الفم والأسنان في المدارس الحكومية، وبما أن هذه الدراسة سيكون لها الأثر الإيجابي لمعرفة أسباب ونسبة انتشار مشاكل صحة الفم والأسنان ووضع برنامج طبي متكامل لصحة الفم والأسنان يتضمن الإجراءات العلاجية والوقائية ومساعدة الأهالي على تفهم أهمية الجانب الوقائي وتشجيع أطفالهم على العناية بصحة الفم والأسنان فإنه لا ممانع لدينا من إجراء هذه الدراسة على أن يتم تزويد إدارة الصحة المدرسية بنتائج البحث الميداني والإحصائيات وتحليل النتائج للإستفادة منها لوضع لخطط المستقبلية للصحة المدرسية وخاصة قسم صحة الفم والأسنان.

الرجاء التواصل مع الدكتورة ماجدة - نائب مدير إدارة الصحة المدرسية على هاتف 6770169-050.

شاكركم لكم حسن تعاونكم معنا ..  
وتفضلوا بقبول فائق الاحترام والتقدير ...

ناصر خليفة البلور  
مدير منطقة دبي الطبية بالإتابة

www.government.ae

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## Appendix III



سلطة مدينة دبي الطبية  
DUBAI HEALTHCARE CITY AUTHORITY



March 26<sup>th</sup> 2014

Dr. Haifa Al Hashimi  
Dental Trainee-Pediatric Dentistry  
Dubai School of Dental Medicine  
Dubai Healthcare City  
Dubai, United Arab Emirates

### Subject: Ethical Approval for Research Protocol

Dear Dr. Al-Hashimi,

This is with reference to the initial protocol application for the research study entitled, "Oral Health Among Children with Cerebral Palsy in Dubai-A Case Control Study" which was submitted to the Dubai Healthcare City Authority-Research Ethics Review Committee (RERC) for review and approval.

It is hereby confirmed that the RERC has reviewed the above application on February 10<sup>th</sup> 2014 and March 17<sup>th</sup> 2014, and has **approved the final submission on March 26<sup>th</sup> 2014**. Therefore, you may now commence your research project in line with the submission made on March 22<sup>nd</sup> 2014 as the final version.

Please note however, that this ethical approval is conditional to the following:

1. It is at the discretion of the principal investigator to ensure that all the scientific details and background information contained within the protocol are validated and substantiated with evidence to ensure credibility of the research outcome.
2. Other regulatory approval/s, needed to conduct the study is/are to be obtained and submitted to the RERC for record keeping.
3. No deviations from or changes to the protocol are to be implemented without prior review and documented approval of the RERC.
4. The research study documentation shall be periodically subject to RERC audit.
5. Upon completion of the study, a "Final Research Study Report" will be required for submission to RERC. Consequently, any abstract/publication should also be brought to the attention of the RERC.

We congratulate you and wish you continued success in DHCC.

Best Regards,

Laheeb Al-Mutwalli  
Director-Licensing Department  
Center for Healthcare Planning and Quality  
Dubai Healthcare City Authority



مركز التخطيط والجودة للخدمات الطبية  
CENTER FOR HEALTHCARE PLANNING & QUALITY

يخضع مركز التخطيط والجودة للخدمات الطبية لسلطة مدينة دبي الطبية | CPQ is regulated by Dubai Healthcare City Authority Regulatory

[www.dhcc.ae/cpq](http://www.dhcc.ae/cpq)

مركز دبي للإدارة الصحية - هاتف: 97143425555، فاكس: 97143624770، بريد إلكتروني: info@cpq.dhcc.ae  
P.O. Box: 505001, Dubai, U.A.E, Tel. + 97143425555, Fax + 97143624770, E-mail: info@cpq.dhcc.ae



## Appendix IV

(Cerebral Palsy children)

### Consent for research:

#### **Research Title: Oral Health Status Among Children with Cerebral Palsy in Dubai-UAE: A Case Control Study**

**Dear parents\guardian:**

We are a group of paediatric dentists from Dubai School of Dental Medicine currently studying the oral health condition in healthy children and special needs children with Down syndrome in Dubai-the United Arab Emirates. Recognizing the oral health problems in this group of children will help us structure a proper dental program according to their treatment needs. We will be visiting the schools and special needs centres to conduct a clinical dental check-up that will take an average of ten minutes depending on the child's cooperation and it is free of charge. You will be provided with a copy of your child's dental examination results. The collected data will be used for research purposes only and your child's information will be kept confidential (The data will be scanned and saved in the electronic file dedicated for the research data on Dubai School of Dental Medicine server). Your child's voluntary participation will serve a great value to the community. This research will provide base line data to be used by the health care providers for the planning of the preventive and curative needs of Cerebral Palsy children and help the families of the children with Cerebral Palsy to understand the importance of preventing oral disease.

- ❖ If you are interested to participate, please sign below.
- ❖ If the child's brother or sister (healthy) would like to participate as well for comparison, please fill a separate consent form and questionnaire.
- ❖ Kindly note that only signed forms with complete answers will be eligible to participate.
- ❖ Only children who meet the study's inclusion criteria will be included.
- ❖ The child's medical records maybe reviewed to obtain necessary information which will be kept confidential.
- ❖ The parent can withdraw their child from the study at any time without any liability on their part and withdrawal will not affect any treatment they receive.
- ❖ The data of the child will be destroyed upon withdrawal from the study.
- ❖ The child's information will be written in the data sheet for the purpose of collecting data. After confirmation of completeness of data, the name will be coded.

I have read and understood the above information and:

☐ Agree

For my child (Name: -----) to participate.

The data might be used for future research projects provided that your child's identity will not be revealed. Approval by Research Ethics Review Committee in Dubai HealthCare City will be obtained for any future use of your child's information.

☐ Agree

☐ Disagree

Name \_\_\_\_\_

Relationship to child \_\_\_\_\_

Contact number – mobile: \_\_\_\_\_

Signature \_\_\_\_\_

For inquiries please call:

Dr Haifa Alhashmi: 050-5241115

Rim Turki : 04-4248624

This research study has been approved by the Research Ethics Review Committee in Dubai Healthcare City, Dubai, and UAE

## Appendix V

## (أطفال الشلل الدماغي)

### عنوان البحث :صحة الفم والاسنان لاطفال الشلل الدماغي في مدينة دبي.

عزيزي ولي الأمر :

نحن مجموعة أخصائيين ( طب أسنان الأطفال من كليه دبي لطب الأسنان ، نجري دراسه حول صحة الفم و الأسنان لدى الأطفال الأصحاء و الأطفال الذين يعانون من الشلل الدماغي على مستوى دوله الإمارات العربية المتحدة .

الهدف الأساسي من هذه الدراسة: التعرف على مشاكل صحة الفم و الأسنان التي تواجهها هذه الفئة في مجتمعنا، وكيفية وضع الحلول المناسبة عن طريق هيكلة برنامج طبي متكامل لصحة الفم والأسنان يلبي احتياجاتهم العلاجية والوقائية و مساعدة الاهالي على تفهم اهمية الجانب الوقائي و تشجيعهم على العناية بصحة الفم و الاسنان لاطفالهم.

كما هو معلوم فإن أي دراسة بحث تستلزم وجود أشخاص ينضمون ويشاركون في الدراسة ،لذا سنقوم بزيارة المدارس و مراكز ذوي الاحتياجات الخاصة( وإجراء فحص أسنان مجاني للأطفال وتسليم نتائج الفحص لكل طفل ، علماً بأن هذا الفحص سيستغرق بمعدل العشرة دقائق اعتماداً على تعاون طفلكم، البيانات التي سيتم رصدها ستستخدم لهذا البحث ،مع الإحتفاظ بسريه تامه للمعلومات الشخصية لطفلك(حيث ان المعلومات سوف تحفظ في الملف الالكتروني الخاص بالبحث الجاري في كلية دبي لطب الاسنان) . علماً بأن لجنة البحوث الطبية وافقت على هذه الدراسة مسبقاً.

مشاركة طفلك في هذه الدراسة هو عمل تطوعي ويعتبر خطوة فعالة نحو مجتمع واعي وصحي.

- اذا كنت ترغب في المشاركة الرجاء التوقيع أدناه
- من دواعي سرورنا مشاركة أبناؤكم الآخرين في الاستبيان ،ويفضل ملء إستمارة أخرى لكل طفل.
- يرجى العلم بان الاستثمارات الموقعة و الاستبيانات الكاملة هي التي ستكون مؤهلة للمشاركة في الدراسة.
- الأطفال المستوفون لشروط البحث سوف يتم ادراجهم في هذه الدراسة.
- قد نحتاج لمراجعته الملف الطبي لطفلك للحصول على المعلومات اللازمه ،حيث سيتم ذلك بخصوصيه تامه.
- ولي الامر له الحق باخراج طفله من الدراسة في اي وقت من غير اية تبعات.
- في حالة انسحاب الطفل من الدراسة سوف يتم التخلص من المعلومات بشكل نهائي .
- معلومات الطفل ستكون مكتوبة على ورقة البيانات و الاستبيان لغرض جمع البيانات ، بعد التأكد من اكتمال البيانات اسم الطفل و بياناته ستكون مشفرة

لقد قرأت وفهمت المعلومات أعلاه , و : ☐ أوافق

بمشاركة طفلي (.....) في هذه الدراسة .

يمكن أن تستخدم البيانات للمشاريع البحثية في المستقبل شريطة أن هوية طفلك لن يتم التعرف عليها. البيانات التي سيتم رصدها ستستخدم للبحوث المستقبلية مع الاحتفاظ بسرية تامة للمعلومات الشخصية لطفلك، مع العلم بأنه ستؤخذ موافقة أخرى من قبل لجنة مراجعة أخلاقيات البحوث العلمية في مدينة دبي الطبية للدراسة المستقبلية

☐ أوافق ☐ لا أوافق

التوقيع :

اسم ولي الأمر:

رقم الهاتف المتحرك :

التاريخ :

شاكرين لكم تعاونكم معنا .....

للاستفسار ارجو الاتصال على الارقام التالية:

د. هيفاء الهاشمي: 052-7776684

ريم تركي: 04- 4248624

## **Appendix VI**

**(Healthy children)**

**Consent for research:**

**Research Title: Oral Health Status Among Children with Cerebral Palsy in Dubai-UAE: A Case Control**

**Dear parents\guardian:**

We are a group of paediatric dentists from Dubai School of Dental Medicine currently studying the oral health of healthy children and special needs children in the United Arab Emirates. Recognizing the oral health problems in this group of children will help us structure a proper dental program according to their treatment needs. We will be visiting the schools and special needs centres to conduct a clinical dental check-up that will take an average of ten minutes depending on the child's and it is free of charge. You will be provided with a copy of your child's dental examination results. The collected data will be used for this research only and your child's information will be kept confidential (The data will be scanned and save in the electronic file dedicated for the research data on Dubai School of Dental Medicine server). This study will provide base line data to be used by the health care providers for the planning of the preventive and curative needs of CP children and help the families of the children with CP to understand the importance of preventing oral disease for CP children. Your child's voluntary participation will serve a great value to the community.

- ❖ If you are interested to participate, please sign below
- ❖ Kindly note that only signed forms with complete answers will be eligible to participate.
- ❖ Only children who meet the study's inclusion criteria will be included.
- ❖ The child's medical records maybe reviewed to obtain necessary information which will be kept confidential.
- ❖ The parent can withdraw their child from the study at any time without any liability on their part and withdrawal will not affect any treatment they receive.
- ❖ The data of the child will be destroyed upon withdrawal from the study.
- ❖ The child's information will be written in the data sheet and questionnaire for the purpose of collecting data. After confirmation of completeness of data the name will be coded.

I have read and understood the above information and:

☐ Agree

For my child (Name: -----) to participate.

The data might be used for future research projects provided that your child's identity will not be revealed. Approval by Research Ethics Review Committee in Dubai HealthCare City will be obtained for any future use of your child's information.

☐ Agree

☐ Disagree

Name \_\_\_\_\_

Relationship to child \_\_\_\_\_

Contact number – mobile: \_\_\_\_\_

Signature \_\_\_\_\_

For inquiries please call:

Dr Haifa Alhashmi: 052-7776684

Rim Turki : 04-4248624

This research study has been approved by the Research Ethics Review Committee in Dubai Healthcare City, Dubai, and UAE

## (الأطفال الاصحاء)

عنوان البحث : صحة الفم والاسنان لأطفال الشلل الدماغي في مدينة دبي .

عزيزي ولي الأمر :

من كليه دبي لطب الأسنان ، نجري دراسته حول صحة الفم و الأسنان لدى الأطفال ( طب أسنان الأطفال ) نحن مجموعة أخصائيين الأصحاء و الأطفال من ذوي الإحتياجات الخاصة على مستوى دوله الإمارات العربية المتحدة .

الهدف الأساسي من هذه الدراسة: التعرف على مشاكل صحة الفم و الأسنان التي تواجهها هذه الفئة في مجتمعنا، وكيفية وضع الحلول المناسبة عن طريق هيكلة برنامج طبي متكامل لصحة الفم و الأسنان يلبي احتياجاتهم العلاجية والوقائية.

كما هو معلوم فإن أي دراسة بحث تستلزم وجود أشخاص ينضمون ويشاركون في الدراسة ،لذا سنقوم بزيارة المدارس و مراكز ذوي الإحتياجات الخاصة( وإجراء فحص أسنان مجاني للأطفال وتسليم نتائج الفحص لكل طفل ، علماً بأن هذا الفحص سيستغرق بمعدل العشرة دقائق اعتماداً على تعاون طفلكم، البيانات التي سيتم رصدها ستستخدم لهذا البحث ،مع الإحتفاظ بسريته تامه للمعلومات الشخصية لطفلك(حيث ان المعلومات سوف تحفظ في الملف الالكتروني الخاص بالبحث الجاري في كلية دبي لطب الاسنان) .

مشاركة طفلك في هذه الدراسة هو عمل تطوعي ويعتبر خطوة فعالة نحو مجتمع واعي وصحي.

- اذا كنت ترغب في المشاركة الرجاء التوقيع أدناه
- يرجى العلم بان الاستثمارات الموقعة و الاستبيانات الكاملة هي التي ستكون مؤهلة للمشاركة في الدراسة.
- الأطفال المستوفون لشروط البحث سوف يتم ادراجهم في هذه الدراسة.
- قد نحتاج لمراجعته الملف الطبي لطفلك للحصول على المعلومات اللازمه ،حيث سيتم ذلك بخصوصيه تامه.
- ولي الامر له الحق باخراج طفله من الدراسة في اي وقت من غير اية تبعات.
- في حالة انسحاب الطفل من الدراسة سوف يتم التخلص من المعلومات بشكل نهائي.
- معلومات الطفل ستكون مكتوبة على ورقة البيانات و الاستبيان لغرض جمع البيانات ، بعد التأكد من اكتمال البيانات اسم الطفل و بياناته ستكون مشفرة

لقد قرأت وفهمت المعلومات أعلاه , و :

☐ أوافق

بمشاركة طفلي (.....) في هذه الدراسة .

يمكن أن تستخدم البيانات للمشاريع البحثية في المستقبل شريطة أن هوية طفلك لن يتم التعرف عليها. البيانات التي سيتم رصدها ستستخدم للبحوث المستقبلية مع الاحتفاظ بسرية تامة للمعلومات الشخصية لطفلك، مع العلم بأنه ستؤخذ موافقة أخرى من قبل لجنة مراجعة أخلاقيات البحوث العلمية في مدينة دبي الطبية للدراسة المستقبلية

☐ أوافق ☐ لا أوافق

التوقيع :

اسم ولي الأمر:

التاريخ :

رقم الهاتف المتحرك :

شاكرين لكم تعاونك معنا.....

للاستفسار الرجاء الاتصال على الأرقام التالية:

د. هيفاء الهاشمي: 052-7776684

,ريم تركي: 04- 4248624

تمت الموافقة على هذه الدراسة البحثية من قبل لجنة مراجعة أخلاقيات البحث العلمي في مدينة دبي الطبية ، دبي ، الامارات العربية المتحدة



## Appendix VIII

Child's Name:	Age:	Sex:	Date:
Child's condition :		School/Area:	

Permanent	Primary
0 sound	A
1 decayed	B
2 filled & decayed	C
3 filled, no decay	D
4 missing due caries	E
5 missing, other reason	-
6 sealant	-
7 bridge abutment, crown	G
8 unerupted	-
9 excluded	-

			E	D	C	B	A	A	B	C	D				E
8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8
8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8
			E	D	C	B	A	A	B	C	D	E			
Prim. Teeth	o		d			m		f		dmf					
Perm. Teeth	O		D			M		F		DMF					

Codes for individual tooth status: small letters for primary teeth, capital letter for permanent teeth.  
 O = Sound tooth. , d / D = Decayed tooth. , m / M = Missed. , f / F = Filled

D=  M=  F=  D+M+FT=	d=  m=  f=  d+m+ft=
---------------------------------------	---------------------------------------

## Oral Hygiene Status

Debris index (0,1,2,3)

Calculus Index (0,1,2,3)

Oral Hygiene Index – Simplified = PI + CI

### Debris -67

	Right molar		Anterior		Left molar		Total	
	Buccal	Lingual	Labial	Labial	Buccal	Lingual	Buccal	Lingual
Upper		-		-		-		-
Lower	-		-		-			

**Debris Index** = (The buccal-scores) + (The lingual-scores) / (Total number of examined buccal and lingual surfaces).

**Debris Index =**

### Calculus

	Right molar		Anterior		Left molar		Total	
	Buccal	Lingual	Labial	Labial	Buccal	Lingual	Buccal	Lingual
Upper		-		-		-		-
Lower	-		-		-			

**Calculus Index** = (The buccal-scores) + (The lingual-scores) / (Total number of examined buccal and lingual surfaces).

**Calculus Index**

=

**Oral Hygiene Index**

=

**Debris Index + Calculus Index**

Gingivitis

☐ Yes ☐ No

Gingival Hyperplasia

☐ Yes ☐ No

Debris ☐ Yes ☐ No

Calculus ☐ Yes ☐ No

### Occlusion anomalies

#### Vertical:

1. Open

2. Deep

Yes	No
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>

bite

bite

Angle malocclusion  
classification:

Class I

Class II

Class III

Primary Molar classification:

Flush Terminal Plane

Mesial step

Distal step

#### Transverse

1. Crossbite

2. Scissor bite

Yes	No
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>

(63)

#### Spacing

1. Anterior

2. Posterior

Yes	No
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>

Overjet = ..... mm

#### Trauma – Anterior teeth

Yes

☐

No

☐

If reverse overjet = ..... mm

### **Dentofacial abnormalities**

	Yes	No
1. Shovel shaped incisors		
2. High arched palate		
3. Microdontia		
4. Nippled appearance of canine tip		
5. Tongue thrust		
6. lymphadenopathy		

### **Soft tissue abnormalities**

Oral lesion ( yes / No)	Yes	No
• Atrophy of tongue papilla		
• Median rhomboid glossitis		
• Geographic tongue		
• Fissure tongue		
• Irritation fibroma		
• Angular chilitis		
• Gingival hyperplasia		
• Macroglossia		
• Ulcer		
• Trauma to soft tissue/lip		

## Tooth wear Index - walker et al

### Permanent Dentition

- Circle the highest score you observe (only **upper incisors –Labial + palatal** and **1<sup>st</sup> molars \_ Occlusaly**) or 2<sup>nd</sup> molar

### Primary Dentition

- Circle the highest score you observe (only primary **incisors**)

Code	Depth	Area of surface affected
0	Normal	normal
1	Enamel only	Less than 1/3 of surface involved
2	Enamel and dentine	1/3 up to 2/3 of surface involved
3	Enamel dentine and pulp	2/3 or more of surface involved
9	Assessment cannot be made	Assessment cannot be made

