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**EVALUATION OF DROOLING, DENTAL CARIES AND ORAL
HYGIENE IN CEREBRAL-PALSIED INDIVIDUALS**

VASILIKI TZIFA

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SUPERVISOR

Prof. Dr İLKNUR TANBOĞA

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Prof.Dr. İlknur TANBOĞA

Sınav Jüri Üyeleri (Unvan, Adı, Soyadı)

Prof. Dr. Ali MENTEŞ

Prof. Dr. Işın ULUKAPI

Kurumu

M.Ü. Diş Hek. Fak. Pedodonti Ab.D.


M.Ü. Diş Hek. Fak. Pedodonti Ab.D.

O.Ü. Diş Hek. Fak. Pedodonti Ab.D.

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ABBREVIATIONS

1. <: Smaller than
2. >: Greater than
3. \geq : Equal to or greater than
4. ADA: American Dental Association
5. CP: Cerebral Palsy
6. DMFT: Decayed Missed Filled Teeth Index
7. dmft: decayed missed filled teeth index (for primary dentition)
8. R_s : Spearman's correlation coefficient value
9. SPSS: Statistical Package for Social Studies
10. OHI-S: Simplified Oral Hygiene Index
11. OHRQ: Oral health-related quality of life
12. QOL: Quality of life
13. N_2O : nitrous oxide
14. WHO: World Health Organization

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1.SUMMARY

Evaluation of drooling, dental caries and oral hygiene in cerebral-palsied individuals

Vasiliki TZIFA

Supervisor: Prof Dr Ilknur TANBOĞA

Department of Pediatric Dentistry

Aim: Cerebral Palsy (CP) is the third most common major developmental disability after autism and mental retardation. A prominent portion of children and adults with cerebral palsy remains at high risk for caries development. Also, the literature reports unsatisfactory oral hygiene in these individuals. Drooling when present, can cause a series of disturbances for both the individual and the family. The aim of this study was to evaluate the oral status, the drooling prevalence and determine the risk factors for caries prevalence of individuals with CP, upon the hypothesis that they have increased need of dental treatment and care in comparison with healthy study group.

Material and Methods: This study enrolled 106 subjects, 53 of them with CP (study group) and the 53 subjects nondisabled group (control group) aged from 4 years old to 20 years old.

Results: The CP group had statistically significantly higher caries prevalence and scores of oral hygiene index from the control group.

Discussion: Moreover the caries prevalence and the oral hygiene scores were affected by the type of the nutrition of the CP group. Drooling was prevalent in the 24% and there was not any significant correlation between the caries, the oral hygiene and the drooling in the CP group. Also the type of CP did not affect the outcome for drooling; however the presence of seizures increased its risk.

Conclusion: CP individuals are at more risk for caries and drooling than general population.

Key words: Cerebral palsy, risk factors, dental caries, oral hygiene, drooling

2. ÖZET

Serebral Palsi' li bireylerde oral hijyen, diş çürüğü ve artmış salya akışı incelenmesi

Vasiliki TZIFA

Danışman: İlknur TANBOĞA

Pedodonti Anabilim Dalı

Amaç: Serebral Palsi; otizm ve mental retardasyondan sonra en yaygın üçüncü gelişim bozukluğudur. Serebral Palsi'li bireylerin büyük çoğunluğu çürük konusunda risk taşımaktadır. Artmış salya akıntısı bu birey ve aile için rahatsızlıklara yol açmaktadır. Serebral Palsi taşıyan grubun, popülasyonun geneline kıyasla daha fazla diş tedavisine ve bakıma ihtiyacı olduğu teorisinden yola çıkarakaraştırmanın amacı Serebral Palsi' li bireylerde oral hijyen, diş çürüğü ve artmış salya akıntısını değerlendirmektir. **Gereç ve Yöntem:** Araştırmaya, yaşları 4 ile 20 arasında değişen, 53' ü Serebral Palsi li, 53' ü sağlıklı toplam 106 kişi dahil edilmiştir. **Bulgular:** Serebral Palsi'li grupta,diş çürüğü ve oral hijyen indeks değerleri kontrol grubuna göre istatistiksel olarak daha yüksek bulunmuştur. **Tartışma:** Diş çürüğü ve ağız hijyeni skorları ile beslenme türü arasında istatistiksel olarak anlamlı ilişki olduğu belirlenmiştir. Artmış salya akıntısı, Serebral Palsi grubunun %24' ünde görülmektedir. Buna karşılık, artmış salya akıntısı ile diş çürükleri ve ağız hijyeni arasında istatistiksel olarak anlamlı birilişki olmadığı bulunmuştur. Ayrıca, Serebral Palsi' nin alt grupları ile artmış salya akıntısı arasında anlamlı bir ilişki olmamakla birlikte, bireylerde Serebral palsiye bağlı olarak gelişen nöbetlerin varlığının artmış salya akışı riskini arttırdığı belirlenmiştir.**Sonuç:** Serebral Palsi'li bireyler,sağlıklı bireylere göre çürük ve salya akıntısı açısından daha fazla risk taşımaktadırlar.

Anathar kelimeler: Serebral Palsi, risk faktörleri, diş çürüğü, ağız hijyeni, salya akıntısı

3. INTRODUCTION AND AIM

Various epidemiological studies have attempted to define the treatment need of special care patients and evaluate differences in need with comparison to the general population. (Feldman et al., 1997; Nunn, 2000)

Oral health is often considered as a probable issue of health inequalities in persons with neuromotor and mental deficiencies. The quality of the evidence base supporting this assumption is not high despite numerous studies reporting poor oral health in patient groups with disabilities.(Hennequin et al., 2008) Many studies have no control group, use inappropriate indicators or report a partial evaluation of oral health. (Hennequin et al., 2008) Is therefore very important and essential to foster epidemiological and cross-sectional studies on prevalence and types of oral health conditions in infants, children, and adolescents with neurodevelopment disabilities and other children with special health care needs in community and institutional settings, consider surveillance studies of certain groups of children with special health care needs and monitor important health benchmarks including immunizations, oral evaluations, and dental referrals. (Mouradian et al.,2001)

Children with neurodevelopment disabilities and other special health care needs are at increased risk for oral problems. (Mouradian et al.,2001) Also they might be at special risk for oral disease due to delays in acquiring self-acquiring self-care skills, knowledge, and understanding needed to promote oral health. (Mouradian et al.,2001)

Cerebral Palsy (PS) is the third most common major developmental disability after autism and mental retardation. (Cooley, 2004) It describes a group of movement and postural development disorders that are attributed to nonprogressive disturbances that occur in the developing fetal or infant brain, causing limited activity. (Bax et al., 2005) Moreover, it is also described as a heterogeneous group of neuromotor

conditions involving disordered movement or posture and weakness resulting from a nonprogressive brain lesion, injury, or malformation occurring prenatally or first 2 years of life. (Cooley, 2004). The causes can be congenital, genetic, inflammatory, anoxic, traumatic, toxic, and metabolic. (Cooley, 2004) Mental retardation, speech, vision impairment and uncontrolled oral and perioral muscles are present contributing to difficulties in mastication, swallowing and accumulation of debris in the oral cavity. (Weddell et al., 2004)

The prevalence of cerebral palsy among children is 1.5/2 to 2.5 per 1000. (Odding et al., 2006; Paneth 1984) The precise number of adults with cerebral palsy is not known but the number has estimated 400000. (Murphy et al., 1995)

Although caries prevalence overall has declined, a prominent portion of children and adults with cerebral palsy remain at high risk for caries development due to the difficulty in seeking, accessing dental care, the ability of detecting painful stimuli and their socio-economic status. (Freysleben et al., 2000; Sonis et al., 1997; Santos et al., 2009) Also there is reported correlation between oral hygiene and caries experience. (Alhammad and Wyne 2010)

Oral hygiene it remains a critical point for these patients because of the necessity of maintaining them under optimum oral health conditions. However the literature reports unsatisfactory oral hygiene in these individuals and increased plaque accumulation. (Weddell et al., 2004)

Drooling (siglorrhoea) is normal in young infants; but beyond 4 years of age is considered abnormal. Drooling is an overflow of saliva from mouth because of dysfunctional voluntary oral motor activity, improper swallowing or oral deficits but rarely because of hypersalivation. (Wong et al., 2001) It is estimated that 10% of cerebral palsy children have drooling problems. (Harris et al., 1987; Lespargot et al., 1993; Makhani 1974; Van de Heyning et al., 1980) Drooling can cause a series of disturbances for both the individual and the family and also there is the need to evaluate the severity and the association, if any, with the general oral status.

The aim is to evaluate the oral, the dental and the drooling status, to determine the risk factors for caries prevalence of these individuals based on the hypothesis that they have drooling problems and increased need of dental treatment and care in comparison with general population.

4. LITERATURE REVIEW

4.1 Oral health, Quality of life (QOL) and health promotion in special populations

Oral health is more than teeth. Oral health includes all the sensory digestive, respiratory, structural and emotional functions of the teeth, oral cavity and contiguous structures which is essential for optimal nutrition, pulmonary health, speech, social function and well-being. (Mouradian et al., 2001) There is no database to document the accurate oral health status of children with neurodevelopment disabilities or other special needs. (Horowitz et al., 2001)

Quality of Life is an important construct for understanding health outcomes for individuals with disabilities and chronic conditions. It is the individual's perception of their position in life in relation to goals, expectations and concerns in the context of their own culture. Interventions, such as repairing a cleft lip to improve social adjustment, often aim at improving QOL. Families, providers, and researchers must struggle with the definition and measurement of QOL, especially in children, who cannot give informed consent. Such efforts are essential to weighing risks and benefits for children, as well as quantifying for health administrators and payers the impact of conditions and effectiveness of treatment. More research in this area is urgently needed. (Mouradian et al., 2001)

Studies of disease prevention or health promotion interventions in the context of special populations are very limited, and it may not be appropriate to extrapolate from general populations. (Mouradian et al., 2001) It is difficult to aggregate data from this large, diverse population of individuals with varying conditions and social circumstances. Data collection at state and national levels is needed. The majority of the literature in the field of developmental disabilities reports clinical experience and anecdotes. Much work remains to be done in this area. (Mouradian et al., 2001) Is

important to mark in that point that even if their oral status do not command special treatment they should receive preventive care as part of complete care for not being at risk of having any oral disease which can complicate their situation in many ways. (Mouradian et al., 2001)

While children and families with special needs share many of the same general needs and concerns, differences between and within health conditions raise other important policy issues. The spectrum of these concerns should be addressed in service, policy, research, and training efforts. Important services needed by all children with special health care needs include comprehensive, coordinated interdisciplinary team care that includes oral health concerns, primary care “medical homes” for coordination of health services and family needs, and regular oral health monitoring by a “dental home” or other appropriate sources of oral health care. (Mouradian et al., 2001) The scope of oral health issues—including dental, nutrition/feeding, oral-motor, and speech concerns—should be addressed by interdisciplinary health teams with appropriate oral professionals included on such teams. There is a need to address insurance coverage for interdisciplinary team care. (Mouradian et al., 2001)

4.2. Access to dental care for individuals with special health care needs

The United States Surgeon General has identified children with special health care needs among those groups who are experiencing difficulty gaining access to dental care in the United States. (Evans and Kleinman, 2000) The last three decades reports in the dental literature stated that dentists are generally reluctant to care for disabled populations suggesting also that practitioners experience various obstacles to care of the disabled from low reimbursement to inadequate dental school training. (Siegal, 1985) From the mid-80s curriculum guidelines were established to assist dental education in providing instruction about the needs of special care patients. (American Association of Dentistry, 1985)

There was a national study conducted in America about general dentists' care of children whose data offered a unique opportunity to gauge the profession's care of children who also have special health care needs. (Casamassimo et al., 2004) Results of this study on the effect of education supports the positive effect of education on the likelihood of caring for these patients and the finding that dentists who had not been exposed to hands-on and lecture were less likely to care for them. It is also encouraging to note that dentists who had been educated in providing this special care perceived fewer barriers to providing care to special needs patients which of these reinforces the previous author's claim for more knowledge and training needed.

The findings, also, from the same national survey indicate that fewer than one in ten general practitioners often see children with cerebral palsy, mental retardation, or who are medically compromised confirming similar previous documentation that dental care is one of the greatest unmet health care needs for this population. (Casamassimo et al., 2004; Siegal 1985)

Furthermore, it is demonstrated also that often the dental need of these special care patients is underestimated by both their carers and the dental profession and there is need of a system that will ensure that these people will be targeted as a group in particular need of preventive care, access for dental care, for care under general anaesthesia when needed, and not been neglected as dental patients.(Hennequin et al., 2000)

In that spirit, various epidemiological studies have attempted to define the treatment need of special care patients and evaluate differences in need with comparison to the general population to reinforce the further interest of the dental community. (Feldman et al., 1997; Nunn 2000)

4.3 Cerebral Palsy

4.3.1 Definition, epidemiology

Cerebral Palsy is the third most common major developmental disability, after autism and mental retardation. (Cooley, 2004) CP frequently includes paresis and incoordination and can result in involuntary movements.(Ingram 1964; Scoles 1982) In other words, CP is the most common cause of motor disability in childhood. (Yeargin-Allsopp, 2008)

In a recent International Workshop about the Definition and Classification of Cerebral Palsy it was agreed supporting and improving all the previous definitions that, “Cerebral palsy describes a group of permanent disorders of the development of movement and posture, causing activity limitation, that are 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, perception, cognition, communication and behavior, by epilepsy, and by secondary musculoskeletal problems.”(Rosenbaum et al., 2007)

Prevalence, usually expressed as a number or ratio, is the total number of people with cerebral palsy in a certain place whereas incidence is a rate , looks at the number of children born with cerebral palsy within a specific time period and answers the question “How often does cerebral palsy occur?”.(https://www.cerebralpalsy.org.au , Date of access: 24 June 2014) For instance, it is estimated there are 764000 children and adults living with cerebral palsy in the United States and it is estimated approximately 8,000 to 10,000 babies born each year will develop cerebral palsy. (https://www.cerebralpalsy.org.au , Date of access: 24 June 2014) Others refer to prevalence as 1,5 to 2,5 per 1000. (Murphy et al., 1987; Paneth 1984; Oxford Registrar of early childhood impairment, 1983) There has also been a gradual increase in the prevalence of cerebral palsy from the mid-1960s to the mid-1980s, which parallels the increasing survival of low-birth weight infants. (Kudrjances et al., 1983; Hagberg et al., 1989). The precise number of adults with cerebral palsy is not known, but the number has been estimated at 400 000. (Murphy et al., 1995) Ninety-five percent of children with diplegia and 75% of children with

quadriplegia survive until the age of 30 years.(Chrichton et al., 1995) Ninety percent of children with mild mental retardation and 65% of children withsevere mental retardation survive until the age of 38 years. (Chrichton et al., 1995) Overall survival of all children with cerebral palsy until the age of 20 years is 90%. (Evans et al., 1990) Therefore there is an important amount of child (60 to 90%) that survive through adulthood and the incidence may continue to increase because of increased survival of low-birth- weight infants and increased longevity of the general population. (Rapp and Torres, 2000) In other words surviving premature infants with birth weight less than 1500g experience a risk of cerebral palsy of 90 per 1000 live births, and 50% of new cases of cerebral palsy occur in infants weighing less than 1000g at birth. (Kuban and Leviton 1992) (Figure 1)



Figure 1: CP patient

4.3.2 Etiology and risk factors

It has been long known that there is an association with birthweight. (Lawson and Badawi, 2003) Children of 32-42 weeks gestation with a birthweight for gestational age below the 10th percentile are 4-6 times more likely to have CP than children between the 25th and 75th percentile. (Odding et al., 2006) Studies on

possible risk are still abundant and trying to investigate causes of CP concluding many possible passways many of which are not identified yet. (Odding et al., 2006)

Risk factors generally can be identified as prenatally, perinatally and postnatally acquired. In term children, 51% are classified as prenatal, 36% as perinatal and 14% as combined whereas in preterm children are 12%, 61% and 27% accordingly. (Hagberg et al., 2001) Among the prenatal risk factors intrauterine infection (chorioamniositis) is the best known especially related with high risk incidence in preterm children and the most important prenatal factor in very low birthweight infants. Also, the prevalence in twins is higher five times and in triplets 19 times than in singletons. (Odding et al., 2006) Periventricular leukomalacia is one of the underlying disorders accounting for much of the CP among children who were very preterm and for perhaps a fraction of CP in infants born at term. (Cowan et al., 2000) Other infections related to the mother are also referred as risk factors such as, rubella, syphilis, herpes or dysfunctions like diabetes, hypertension and thyroid disorder. (Odding et al., 2006) Of these radiation and use of drugs and alcohol increases the incidence. (Odding et al., 2006) During birth also apnea, hypoxia, birth injury and prolonged or difficult labor can contribute in etiology of CP. (Odding et al., 2006) After birth trauma, brain tumors, infections and toxins are factors that raise the possibility of the incidence of cerebral palsy. (Odding et al., 2006)

4.3.3 Type of CP, Characteristics

It has been estimated that about 80% of children with CP have some type of movement disorder. Generally, CP is most often classified as either spastic, dyskinetic\athetoid, or ataxic. (Horstmann and Bleck, 2007) Although spasticity is often the dominant disorder, many children with CP have mixed spasticity and dystonia. (Delgado and Albright 2003). When more than 1 type of movement disorder is present in patients, experts recommend classifying patients by the predominant disorder, for epidemiologic purposes. (Rosenbaum, 2007)

When referring to location of the brain injury, spastic and non-spastic cerebral palsy is referred to in the medical community as pyramidal (spastic) and extrapyramidal (non-spastic) cerebral palsy. Spastic cerebral palsy is often named in combination with a topographical method that describes which limbs are affected, such as spastic diplegia, spastic hemiparesis, and spastic quadriplegia. Non-spastic cerebral palsy is divided into two groups, ataxic and dyskinetic. Together they make up 20% of cerebral palsy cases. Broken down, dyskinetic makes up 15% of all cerebral palsy cases, and ataxic comprises 5%. (Ortega et al., 2007)

Spastic CP has characteristics affecting therefore the involuntary movements resulting in spasticity, hyperreflexia and increased muscular tone. (Ortega et al., 2007) Three-fifths of the total CP cases are spastic. (Rapin, 2000) The other forms have different clinical characteristics. (Ortega et al., 2007)

The traditional classifications with the criteria of topographical distribution for the hypertonic (spastic) form of CP, hemiplegia, diplegia, and quadriplegia/tetraplegia (and occasionally triplegia), continue to be used clinically. However, these classifications have shown poor inter-rater reliability and have been the source of discrepancies in proportions of CP subtypes reported by registries in different countries. (Rapin, 2000) Inconsistencies arise because of lack of definition of how much upper extremity impairment is needed to classify patients as quadriplegic versus diplegic. (Rapin, 2000)

More specific terms are also used based on that classification for the establishment of definitions and classifications of motor disorders, with an ultimate goal of allowing improved communication among clinicians and researchers, and improving classification of patients for clinical and research purposes. To date, definitions have been established for hypertonic and hyperkinetic movement disorders, as well as negative motor signs in children. (Reftlesen et al., 2010)

Based on activity limitation the Gross Motor Function Classification System is can be also used. It is based on self-initiated movement with particular emphasis on sitting and walking. (Rosenbaum et al., 1995) This system rates patients' ambulatory function, including use of mobility aids and performance in sitting, standing, and walking activities. (Reftlesen et al., 2010) Distinctions between levels of motor function are based on functional limitations, the need for assistive technology, including mobility devices (such as walkers, crutches, and canes) and wheeled mobility, and to much lesser extent quality of movement. Level I includes children with neuromotor impairments whose functional limitations are less than what is typically associated with cerebral palsy, and children who have traditionally been diagnosed as having "minimal brain dysfunction" or "cerebral palsy of minimal severity". The distinctions between Levels I and II therefore are not as pronounced as the distinctions between the other Levels, particularly for infants less than 2 years. Specifically, Level I: Walks without limitations, Level II: Walks with limitations, Level III: Walks using a hand-held mobility device, Level IV: Self-mobility with limitations; may use powered mobility, Level V: Transported in a manual wheelchair. (Reftlesen et al., 2010) (Figure 2)

The descriptions of the 5 levels are broad and are not intended to describe all aspects of the function of individual children. (Rosenbaum et al., 1995)

Symptoms of CP may vary from mild to severe, uncontrolled body movements, seizure disorders, sensory impairment speech and communication defects may be present. (Jaccarino, 2009) Additionally there is a 50% prevalence of mental retardation. (Jaccarino, 2009) It affects mainly and primarily the neuromuscular system but secondarily it can also affect other systems as vision, cardiovascular, pulmonary and more. (Rapp and Torres, 2000)

4.3.4 Dental findings, oral status of CP patients

The oral cavity as dental findings and the presence of drooling both examining with the ability of swallowing are important areas that should be taken into account when examining a CP patient. (Liptak et al., 2011)

The masticatory musculature spasticity of CP can interfere daily activities such as tooth brushing, cleaning of the oral cavity and eating. (Manzano et al., 2004) In the literature it is stated that there is still controversy about the incidence of oral diseases in CP. (Oliveira et al., 2011) This can be contributed to the failure of the criteria used to choose the populations as well as the lack of control groups (Brown and Schodel, 1976) However, dental caries, periodontal problems and poor oral hygiene are vastly stated as a prominent characteristic of this group of patients. (Hallett et al., 1995; Guare and Ciamponi 2003; Liptak et al., 2011; Pope and Curzon 1991, Rodrigues dos Santos et al., 2003) Motor and mental alterations as well as dyskinetic movements may hamper dental hygiene in CP individuals. (Dos Santos and Nogueira, 2005) In the largest cross-sectional study about children and adolescents with disability undertaken there was reported poor oral health in comparison with non-disabled population which is also worsened by age. (Hennequin et al., 2008)

Cases of bruxism are also referred but its incidence in CP is still unknown. (Manzano et al., 2004) Moreover, infantile oral reflexes are sometimes present contributing in higher risk for oral diseases due to the difficulty in performing oral hygiene. (Dos Santos and Nogueira, 2005)

4.3.5 Dental needs for CP individuals

Persons with disability have not always the neuromotor abilities required to independently and effectively perform oral hygiene and are mainly dependant from their caregivers. (Faulks et al., 2006) Consequently, care staff and families who help with daily dental hygiene tasks should be targeted for educative programs. (

Frenkelet al., 2002; Glassman and Miller 2003) Accordingly, there is proved a statistical correlation between dental caries of CP patients and the burden on their caregivers. (Santos et al., 2010) In the same spirit Yitzhak recommends that more studies should be done to evaluate the effectiveness of tooth brushing on institutionalised or extern CP residents by their caregivers. (Yitzhak et al., 2013)

The difficulty in examining and especially providing a dental treatment to those kinds of patients is stated. (Rapp and Torres, 2000) Minor dental problems in persons with CP are a management dilemma and often are neglected. (Kaufman et al., 1991) Uncontrolled movements of the trunk or head that accompany CP can cause inadvertent oral trauma from rotary and other invasive instruments that are required in dental practice. (Kaufman et al., 1991) Patients with poor cognitive skills can be treated with oral sedation, restrains and oral sedation, intramuscular or intravenous sedation and general anesthesia. (American Dental Association, 2007) Therefore the understanding of their treatment needs and being preventive is considered to be very important. (Hennequin et al., 2000)

Kaufman and his colleagues in their early study they managed to suppress the involuntary movements of CP patients that can cause dental stress with the use of N₂O (nitrous oxide). (Kaufman et al., 1991) There was not only no increase in excitation but there was total suppression of the involuntary movements. (Kaufman et al., 1991)

There are three main strands to improving oral health in this population: improving oral hygiene, defining specific training for dental professionals, and allocating funds to cover dental care access and service utilization. (Young et al., 2006)

4.4 Drooling

4.4.1 Definition etiology and prevalence

Saliva is important in moistening the mouth and maintaining oral hygiene. It lubricates the bolus while swallowing and helps in regulating oesophageal acidity. Saliva is produced by three major paired glands – the parotid, submandibular, and sublingual glands – and by minor glands located throughout the oral and pharyngeal mucosa. (Erasmus et al., 2009) The submandibular glands produce about 70% of high viscosity resting saliva. In addition, resting saliva is composed of secretions from the parotid glands (about 25%) and sublingual glands (about 5%). (Erasmus et al., 2009) The parotid glands are capable of producing great amounts of watery saliva during eating and drinking. The average person swallows approximately 600ml of saliva each day, although in some individuals it might be as much as 1000ml per day. The pathway of saliva secretion is under autonomic control. Somatosensory, general, and special visceral (gustatory) afferents of the fifth, seventh, ninth, and 10th cranial nerves terminate in the tractus solitarius and salivatory nuclei in the medulla oblongata. A controlling solitarius-hypothalamic circuit has been proposed. (Matsuo and Kusano 1984; Saper et al., 1976) The parasympathetic stimuli enter the submandibular salivary glands by efferents of the seventh nerve and the parotid glands by efferents of the ninth nerve. The preganglionic sympathetic fibres originate in the intermediolateral cell column of the first and second thoracic cord segments and connect to postganglionic nerve fibres in the superior cervical sympathetic ganglion. These postganglionic sympathetic nerve fibres reach the salivary glands running along the external carotid artery. The secretion of saliva is regulated indirectly by the solitarius-hypothalamic circuit ('smelling food makes one's mouth water') and by direct reflexes modulated by tactile, mechanical, and gustatory stimuli. (Erasmus et al., 2009)

Drooling, hypersalivation, sialorrhea, and ptyalism are terms that are relevant to saliva and might cause confusion. (Hussein et al., 1998) Although the last three are synonyms there should be a distinction between hypersalivation and drooling. (Hussein et al., 1998) Drooling is an indication of an up-set in the co-ordinated control mechanism of oro-facial and palato-lingual musculature leading to excessive pooling of saliva in the anterior mouth and resultant unintentional loss of saliva from the mouth. (Cotton and Richardson 1981; Blasco and Allaire 1992) Hypersalivation is an excessive production of saliva and does not necessary leads to drooling as the excess may be swallowed. (Hussein et al., 1998) In drooling there is rarely hypersalivation, authors claim by meticulously examining the literature. (Hussein et al., 1998) Also, Erasmus et al., proved it through examining CP children and healthy children where they did not find any hypersalivation and contributed the drooling in inadequate oral motor control, proving all the previous assumptions. (Erasmus et al., 2009) True hypersalivation is considered to be rare. (Hussein et al., 1998) This is in agreement with Tahmassebi and Cruzon who by studying a population of 10 CP children and 10 non-CP children comparing the flow rate found that CP children do not produce excess saliva. (Tahmassebi and Cruzon, 2003) These studies are important considering there is lack of adequate data on correlation between rate of secretion and clinical drooling.

Drooling is commonly seen in normal infants until 15-18 months of age which is consequence of physiological maturity of oro-facial-motor function. (Blasco and Allaire, 1992) However it is considered abnormal above the age of 4 years old. (Crysdale, 1989) It is mainly seen in children with poor neuromuscular coordination (Blasco and Allaire, 1992) and other physical physical disabilities. (Crysdale, 1989) Occasionally, can occurs also to individuals who have lost the integrity of jaws or lips because of accident, tumors or acquired or congenital defects. (Blasco and Allaire, 1992)

The aetiology is not fully addressed in the literature, although a number of factors that are described below have been considered as influence. (Tahmassebi and

Curzon, 2003) Overall, the direct causes can be summarized as cerebral palsy, neuromotor damage, parkinsonism, congenital suprabulbar palsy, major rejection of the oropharynx whereas indirect causes can be nasal obstruction, malocclusion, tongue thrust, poor lip control, hypoactive gag reflex, jaw stability, head position and concentration on a task. (Hussein et al., 1998) In individuals with mental retardation or cerebral palsy it is related to inadequate swallowing and lip closure. (Harris and Purday, 1987) Drooling can be increased by malocclusions and dental inflammation related to neglect. (Crysdale et al., 2006)

Drooling is generally seen in children with neuromuscular problems such as CP, peripheral neuromuscular disease, facial paralysis and mental retardation. (Hussein et al., 1998) The prevalence related to CP is about 10% and it is referred as severe interfering with everyday activities. (Blasco and Allaire, 1992). Others estimate it from 10 to 37%. (Ekedhal 1974, Heyning et al., 1980)

4.4.2 Effects of drooling

Drooling can have many effects on the child's health and development and on the child's social development and relationships. (Arnrup and Crossner 1990; Domarachi and Sisson 1990) Moreover, it can cause chronically irritated, chapped or macerated facial skin, perioral infections, odthe, dehydration even a chilling feeling in cold weather. (Cotton and Richardson 1981; Blasco and Allaire 1992; Arnrup and Crossner 1990) The environment gets affected and might be distanced from the child/individual leading to its isolation (Finkleisten and Crysdale, 1992)

4.4.3 Management of drooling

Management of drooling in individuals and children with neurological problems has received increased attention in recent years as more treatments options are available. (Yam et al., 2006) Just as drooling has many causes many approaches to

treatment have been employed. (Hussein et al., 1998) No option is universally successful and many have potential complications. (Hussein et al., 1998)

The non-surgical methods are biofeedback techniques, bio-functional appliances, physiotherapy, behavioral therapy, drug therapy and radiotherapy. (Hussein et al., 1998)

The biofeedback appliances are orthopedic and by applying pressure to the chin or by performing anti-drooling classes with various means in order to teach the child to understand when drools. They have showed to reduce up to 73% of the saliva drooled. (Harris and Dignam, 1980) The bio-functional devices that are acrylic appliances with stimulating palatal plate or mouth vestibular brace are used to stimulate oral musculature either with the tongue or with the lips. (Figure 2) The flanges of the device stimulate the cheeks the lips and there has been shown a reduction up to 67% in drooling by improving the swallowing. (Crysdale et al., 1985)

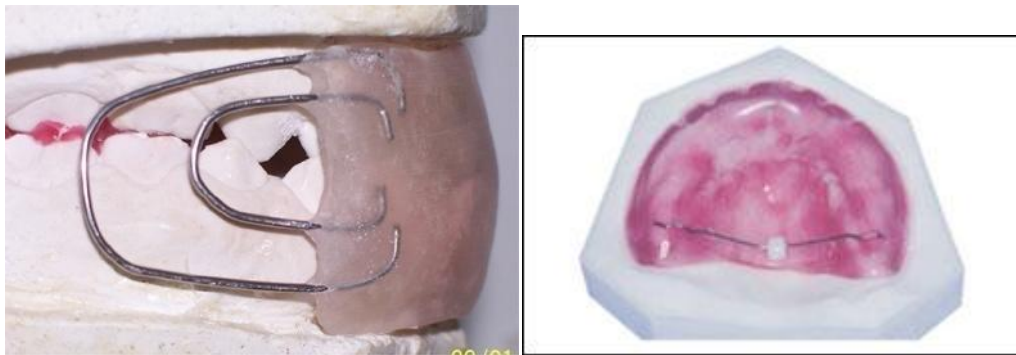


Figure 2: Biofeedback appliances (retrieved from www.cerebralpalsy.org.au ,date of access 24 may 2014)

Another appliance is “Castillo Morales” stimulating plate which can be also used for plate therapy and improve the orofacial appearance and muscle tone contributing

to correct motor function. It was used successfully for correcting mouth posture and tongue position in Down syndrome patients. (Korbmacher et al., 2006) (Figure 3)



Figure 3:“Castillo Morales” stimulating palate (retrieved from www.cerebralpalsy.org.au, date of access 24 may 2014)

For the pharmacological methods, the antimuscarinic anticholinergic drugs are not so proposed because of the side effects they have. (Hussein et al., 1998) Transdermal scopolamine is thought to reduce saliva and it is effective for controlling drooling in disabled patients but still has serious side effects to be taken into concern. (Mato et al.,2010)

Methods like stimulating or brushing the soft tissues in a certain pattern in conjunction to vibration theory showed also to be successful. (Domaracki and Sisson, 1990)

Radiotherapy even though it can reduce dramatically the siallorhea, It is contradicted, because of the side effects of xerostomia and radiation caries and of these of possible later malignancy. (Cotton and Richardson, 1981)

Surgical methods are namely severance of parasympathetic supply of salivary glands, salivary gland duct relocation, ligation and excision. (Hussein et al., 1998) These procedures are outside the scope of dentistry, however, a basic knowledge is required. The surgery is about reducing the amount of saliva produced, redirecting the salivary flow or combination of them. (Blasco and Allaire, 1992)Namely, the

sectioning of the parasympathetic neural pathway, the tympanic neurectomy, the sectioning of the chorda tympani, the relocation of parotid duct and bilateral submandibular gland removal and ligation(Hussein et al., 1998). The relocation or ligation with the combination of submandibular gland excision is the procedure that provides constant control of drooling. (Hussein et al., 1998) All these methods have however the risk of alteration in saliva flow that causes xerostomia, caries and general jeopardize the oral status in CP individuals. (Arnrup and Crossner, 1990) .

The use of Botulinum Toxin A is also newly proposed. It is proved that the toxin A can reduce drooling while maintaining oral healthwhen injected to submandibular glands in low doses. (Wu et al., 2011)

4.4.4 The role of pediatric dentist

The management of drooling is multidisciplinary team's work. The paediatric dentist should diagnose the problem and discuss it with the individual or with parents/caregivers. Any oral or dental inflammation should be treated because it is contributing to excess salivation. (Hussein et al., 1998)All the treatments should be discussed in order to avoid more invasive methods and the dentist should consult the doctor or the neurologist before prescribing any medication. Also the surgical treatments can affect the oral health and therefore the dentist should consult and prevent the dental disease.(Hussein et al., 1998)

5. MATERIAL AND METHODS

5.1 Patient selection and inclusion criteria

This project was approved by the Ethics Committee of Marmara University in Istanbul Turkey in 23 of December in 2013. Written informed consent for participation and publication was obtained from the adult responsible for each CP individual who participated in this study. (Form 1-App 1) Consent was also obtained for screening the non-CP individuals from the school they attend. (App 5)

The study included a convenience sample of all CP individuals attending the Metin Sabanci Institute for Spastic Children/Individuals where they attending ctheses and physiotherapy sessions during the first semester of 2014. Criteria for selection included having a medical diagnosis by phenotype for CP, confirmed both by the caregiver and the institution, and being noninstitutionalized. Both genders and ages ranged from childhood to adolescence.

5.2 MATERIAL

5.2.1 Sampling

This cross-sectional study enrolled 106 subjects, 53 of them with CP(study group) (35 males and 18 females), aged 4 to 20 years old (mean \pm SD; 6 years 7 months \pm 3 years 5 months). (Figure 1) The nondisabled group (control group) comprised by 53 subjects aged from 4 years old to 19 years old (38 males and 15 females) with mean \pm SD; 6 years 9 months \pm 3 years and 1 month) were not CP patients attending a regular school in Sariyer Istanbul Turkey. The control group was consisted of individuals from similar socioeconomic status with the study group. The sample size was calculated with a confidence interval of 95% and a statistical power test at 80% where at least 40 individuals where required for each group.

Both groups had the same proportion of sub groups separated by the criteria of having primary, mixed or permanent dentition.

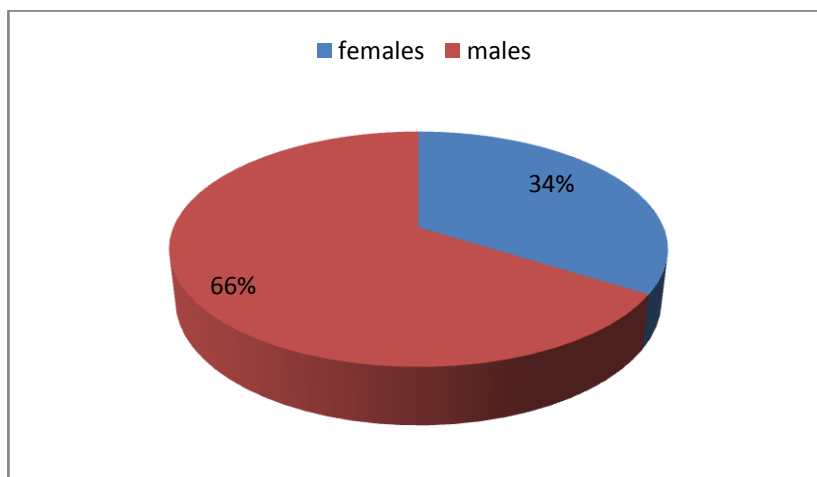


Figure 4: Sex distribution in CP group

5.3 METHODS

5.3.2 Data collection

On the day of the dental visit before the clinical examination the caregivers were asked some questions about medical history, the family's socioeconomic status, questions related to the CP situation, the drooling status, the dietary and brushing habits of the CP individuals. For the dietary habits, questions about the frequency of in-between meals and sugar intake were answered. The education level of the mother and the father was taken into account, the daily frequency of sugar intake (0, 1 to 3 times or more than 3 times) and the daily brushing frequency (0, 1, 2, 3 times per day). The type of the CP was questioned and then cross checked with the medical records given to the institution. Especially for the study group the caregivers were asked about the type of the food the individual is able to consume (all types of food, semisolid-puree or just liquids). They were also asked if they had any dental

treatment before or undergo any preventive dental experience like fluoride application.

After that, total oral health and caries experience assessment was evaluated by the dental examiner, followed by registration of drooling scores.

Similarly, the control group was asked about oral hygiene, dietary habits, the educational and work status of the family and in the end oral hygiene and caries experience was registered.

5.3.3 Oral health and caries experience assessment

An examination was performed of the individual's teeth, including the use of oral hygiene index (OHI-S) and DMFT-dmft scores both for study and control group. Specifically, for dental and oral assessment the subject's teeth examined visually and tactilely under artificial illumination, according to WHO (World Health Organization) procedures (WHO, 1997); caries prevalence assessed using the Decayed, Missing and Filled (DMF/dmf) index for permanent and primary dentitions, respectively. Decayed teeth assessed only at frank cavitation, teeth with white spots lesions will be considered sound (Form 2). For children with mixed dentition the caries index was obtained by the sum of the DMF and dmf.

The oral hygiene will be quantified with the simplified oral hygiene index(OHI-S) developed by Greene and Vermillion(Greene and Vermillion, 1964). The oral hygiene index is vastly used for measuring the oral hygiene in patients (DeStefano 1993; Kolawole et al., 2011; Ojahanon et al., 2013; Podshadley and Haley 1968; Silvinha et al., 2010). The simplified version of the hygiene index is also suggested as a reliable instrument and used in other studies also. (Silvinha et al., 2010; Podshadley and Haley 1968)

Selected surfaces are examined and scored for extent of debris and calculus. The amount of debris was scored as 0 to 3 for each tooth surface depending on the extent to which soft debris or stain covered a tooth surface.

Score 0: for no debris or stain present,

Score 1: soft debris covering not more than one third of the tooth surface, or presence of extrinsic stains without other debris regardless of surface area covered,

Score 2: soft debris covering more than one third, but not more than two thirds, of the exposed tooth surface,

Score 3: soft debris covering more than two thirds of the exposed tooth surface.

The amount of calculus is also scored in the same way depending on the degree of supragingival or subgingival calculus covering the tooth.

Score 0: for no calculus present,

Score 1: supragingival calculus covering not more than third of the exposed tooth surface,

Score 2: supragingival calculus covering more than one third but not more than two thirds of the exposed tooth surface or the presence of individual flecks of subgingival calculus around the cervical portion of the tooth or both,

Score 3: supragingival calculus covering more than two third of the exposed tooth surface or a continuous heavy band of subgingival calculus around the cervical portion of the tooth or both. The scores are totalled and divided to surfaces to obtain the indexes. The oral hygiene is the sum of debris and calculus index. (Form 2)

Registration of drooling signs (Form 2). It is assessed by two techniques. The first is about the caregiver and the burden created by the drooling, if any, in order to include this important and subjective parameter.

Visual analog scale (VAS)—a questionnaire-based scoring system for severity of drooling. (Table 1). This is a semiquantitative scale that will be marked from 0-10 from the chief caretaker, with the severity of drooling scaled as 10 meaning very severe and 0 no drooling. (To et al., 1999, Heine et al., 1996) (Table 2) (Heine et al., 1996)

Table 1 : Visual Analog Scale

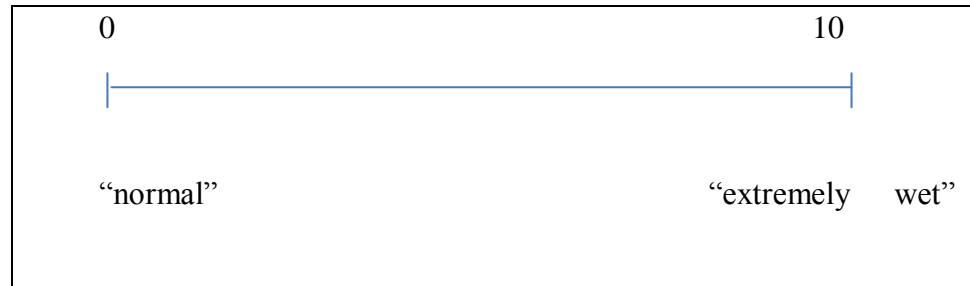


Table 2 :Drooling score

Drooling Severity

Score	Grade	Description
1. Dry		Never drools
2. Mild		Only lips wet
3. Moderate		Wet on lips and chin
4. Severe		Drools to extent that Clothing becomes damp
4. Profuse		Clothing hands, tray and objects become wet

Drooling Frequency

Score	Frequency
--------------	------------------

- | | |
|---|---------------------|
| 1 | Never drools |
| 2 | Occasionally drools |
| 3 | Frequently drools |
| 4 | Constantly drools |

Drooling Score (range 2-9) = drooling severity (range = 1-5) + drooling frequency (range = 1-4)

5.4 Statistical Method

The Statistical package for social science (SPSS-Version#22) was utilized for statistical computation, a significant level $p < 0,05$ was set for all statistical tests. During evaluation of the study results, along with descriptive statistical methods (Median, Standard Deviation), Student t test was used for the intergroup comparisons of parameters with normal distribution and Mann Whitney test was used for the intergroup comparisons of parameters without normal distribution. Spearman's correlation coefficient was used to evaluate the association between of two quantitative variables of the study. When more than two means were to be examined for statistical significance, one way ANOVA test was used.

6. Results

6.1 Caries and oral hygiene assessment between the study and control group

The groups were similar in gender and age. 26 of the subjects with CP had primary dentition (49%), 23 mixed dentition (43,4%) and just 4 permanent dentition (7,5%). The control group was same in proportions. (Table 3)

The DMF scores were higher in all subgroups of CP group in comparison with the control group (Figure 5), but the differences in primary and permanent dentition there was not significant statistical difference. In the mixed dentition, though, there was significant statistical difference ($p < 0,05$). Respectively in total DMF scores, the CP group had higher caries prevalence and statistically significant. (Table 3)

Table 3: Comparison of the mean (\pm SD) values for the DMF index for individuals from the cerebral palsy and control groups

DMF Index	Dentition	Cerebral palsy group		Control Group		p-value
		n(%)	Mean(\pm SD)	n(%)	Mean(\pm SD)	
	Primary	26 (49)	3,3 \pm 3,8	26 (49)	2,2 \pm 2,9	0,292
	Mixed	23 (43.4)	5,0 \pm 3,5	23(43,4)	2,4 \pm 2,5	0,012*
	Permanent	4 (7.5)	4,2 \pm 4,8	4 (7,5)	2,2 \pm 0,9	0,76
	Total	53 (100)	4,2 \pm 3,9	53 (100)	2,3 \pm 3,6	0,025*

The data were compared by Mann-Whitney test $ < .05$; n = sample size, DMF = Decayed, Missing, Filled/decayed missing filled Index.*

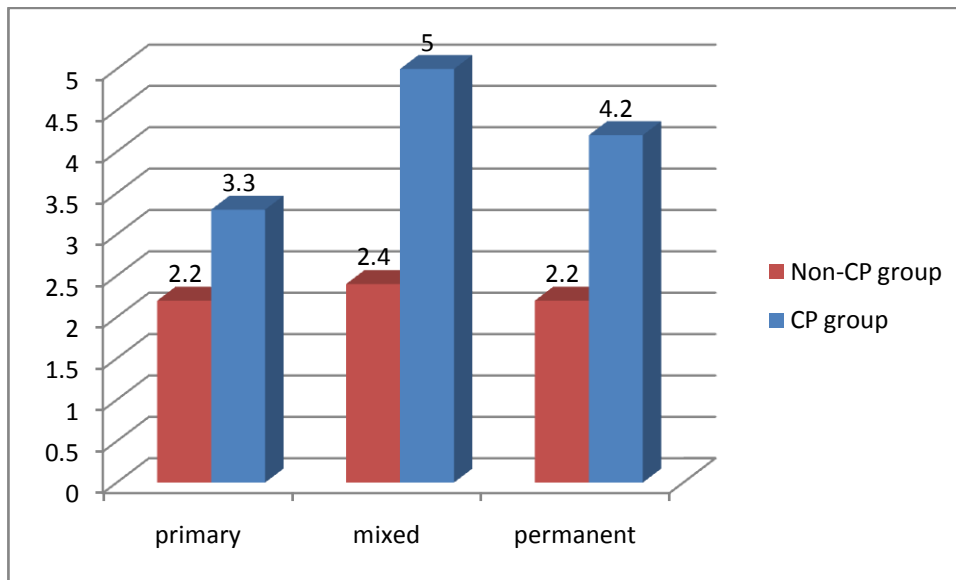


Figure 5: Comparison of the mean values for DMF index for individuals from cerebral palsy and control groups.

For the oral hygiene, using the OHI-S index, the results were as follows. The CP group had higher scores which of these refer to worse oral hygiene, food retention and worse brushing technique as it will be discussed later. In both the primary and the mixed dentition there was statistically significant difference, but not in the permanent group. The total score for all the subgroups is indicating statistically significantly higher scores in CP group. (Table 4 and Figure 6).

Table 4: Comparison of the mean (\pm SD) values for the simplified oral hygiene index(OHI-S) for individuals from the cerebral palsy and control groups.

OHI-S Index		Cerebral palsy group		Control Group		p-value
		n(%)	Mean(\pm SD)	n(%)	Mean(\pm SD)	
	Primary	26 (49)	0,75 \pm 0,61	26 (49)	0,35 \pm 0,25	0,006*
	Mixed	23 (43,4)	0,75 \pm 0,73	23(43,4)	0,37 \pm 0,29	0,013*
	Permanent	4 (7,5)	1,29 \pm 0,28	4 (7,5)	0,75 \pm 0,75	0,248
Total		53 (100)	0,79 \pm 0,65	53 (100)	0,39 \pm 0,33	0,0001*

The data were compared by Mann-Whitney test $* < .05$; n = sample size, OHI-S= The sum of debris and calculus index.

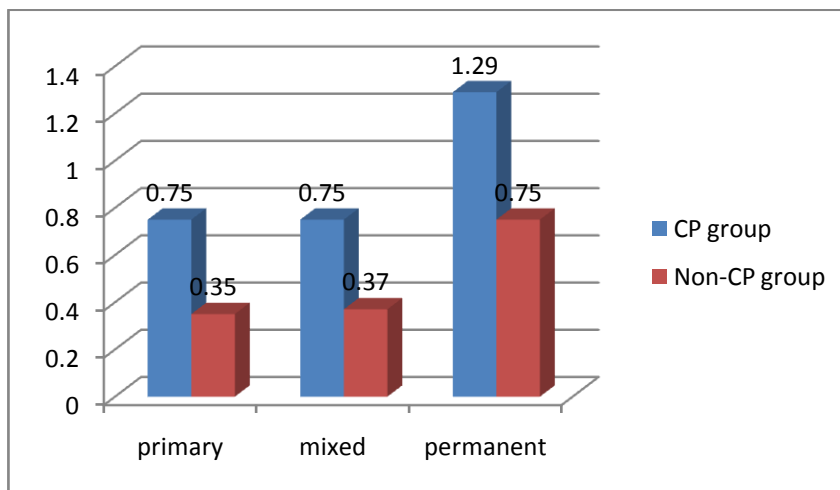


Figure 6: OHI-S scores for CP and control groups

For the CP group the D M and F indexes separately were not distributed normally, which shows the gap between dental need for treatment and treatment received. (Table 5, Figure 7)

Table 5: Mean values for DMF index for the CP group

D	M	F
3,8 ±3,8	0,2 ±0,82	0,1 ±0,82

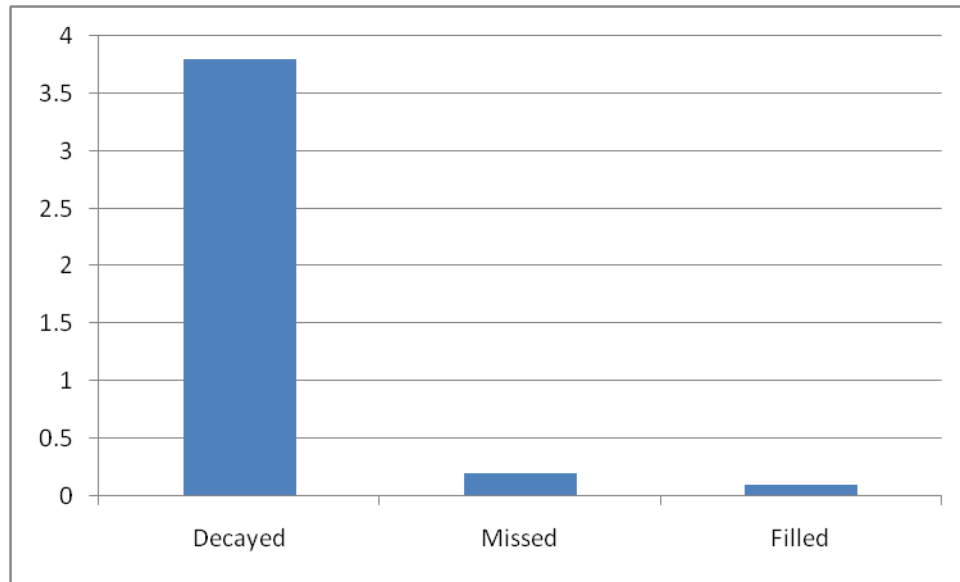


Figure 7: Distribution of D,M and F indexes' score in the study group

Between the DMFT score and oral hygiene score there was statistically significant correlation, ($p=0,000$, $R_s=0,478$ checked with Spearman's coefficient correlation value) as expected.

In summary for the hypothesis of caries prevalence and oral hygiene, the CP group has higher rates and a worse oral hygiene totally. Also there is a correlation between neglected oral hygiene and more caries activity in the study group as expected.

6.2 The impact of socioeconomic level of the family to caries prevalence and oral hygiene in CP group

The family as the main caregivers were asked for their educational level as if they are graduated from just primary school, secondary, high school or university. Both for the mother and the father the data was taken and separated as less than 8 years including primary and secondary school and more than 8 years including graduation from high school and university. The CP patients with fathers with high education were 74.6% and with high education mothers 54.9%. There was not statistically significant difference between the different education level and the scores of DMF index and OHI-S. (Table 6) Therefore, in the study group, the social level of the family-caregivers did not have an impact in the oral status of the CP individuals.

Table 6: Comparison of the social status of the family and DMF and OHI-S scores.

Father's educations-OHI- S	n(%)	Mean Score	±(SD)	p- value
< 8 years	13 (25,4)	1,09	0,76	0,078
> 8 years	38 (74,6)	0,72	0,6	
Mother's education				
< 8 years	23 (45,1)	0,87	0,66	0,51
> 8 years	28 (54,9)	0,75	0,66	

Father's education-DMFT	n (%)	Mean Score	±(SD)	p- value
< 8 years	13 (25,4)	5,38	4,31	0,176
> 8 years	38 (74,6)	3,65	3,77	
Mother's educations- DMFT				
< 8 years	23 (45,1)	4,61	3,61	0,521
> 8 years	28 ((54,9)	3,89	4,19	

Calculated with t-test (p<0.05)

6.3 The type of CP diagnosed, the presence of seizures and their correlation with caries prevalence and oral hygiene

Taking into account the more standard and used classification about CP, the patients were separated into spastic ataxic and athetoid/dyskinetic. For the statistical analysis to find any correlation between the type of CP and the oral status they were separated as spastic and non-spastic which is the wider classification about CP phenotype. Therefore, 6 of them were classified as non-spastic (ataxic, athetoid/dyskinetic), 45 as spastic and for 2 of them the exact type of the CP was not classified. (Figure 8) There was not statistically significantly difference for the different types of CP and their scores for caries prevalence and oral hygiene (Table 9, Table 10)

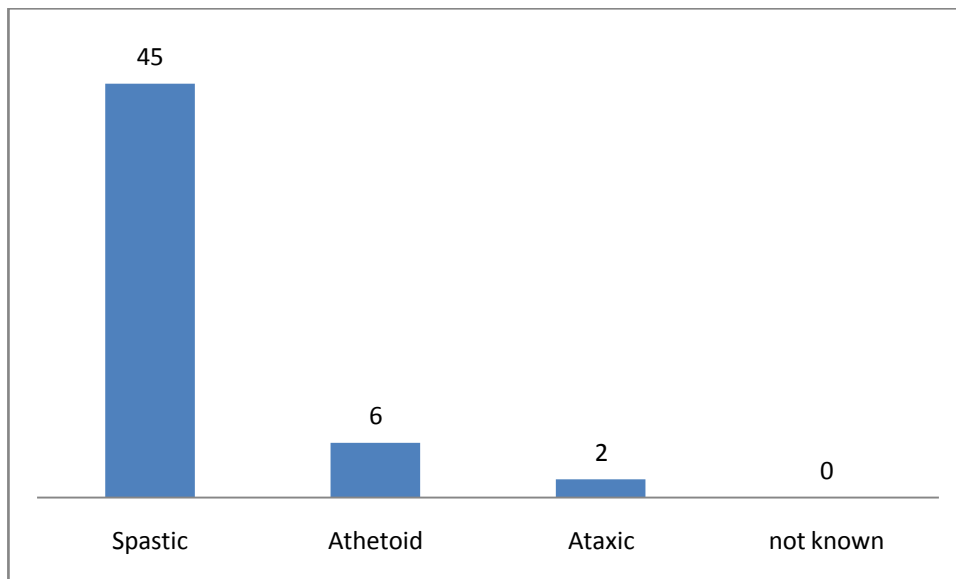


Figure 8: Distribution of CP type for the study group

For the epileptic CP patients the caries activity was not also statistically significantly different the CP patients who had no seizures. (Table 9)

6.4 Brushing habits and sugar intake

As it showed in the study the frequency of brushing and the sugar intake has not any statistically significant impact on the DMF index for the study group. (Table 8) Based on the families' claims, the brushing frequency is adequate for the majority of the CP individuals participated in the study. Therefore, the higher scores can be contributed to the brushing technique and the education of the caregiver rather than the frequency, as it will be discussed meticulously later. Only 9 of them did not have yet started to have brushing habits. (Figure 9)

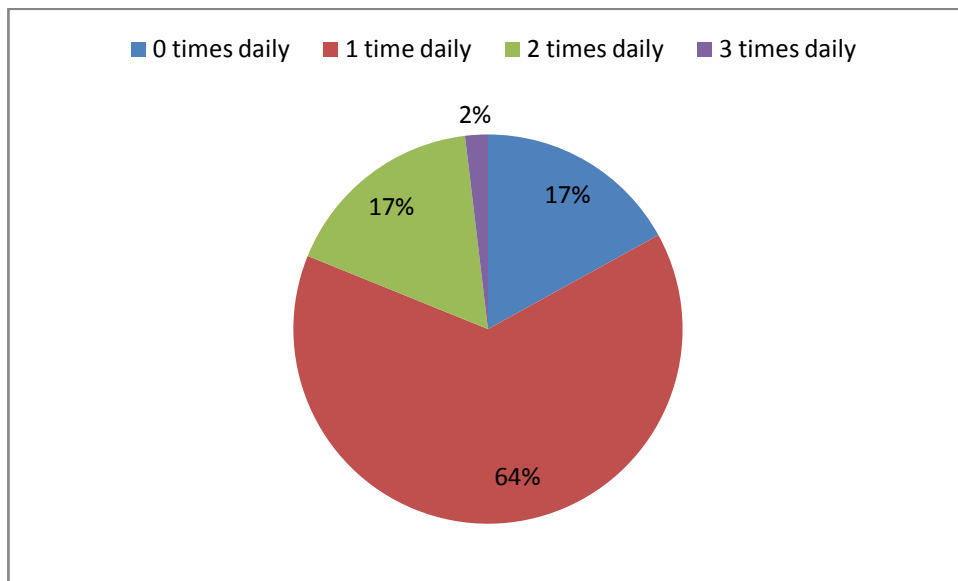


Figure 9: Daily frequency of brushing in the CP group

Also the frequency of sugar intake of any form, was relatively controlled, and not exceeded; based on the caregivers/families' answers. (Figure 10)

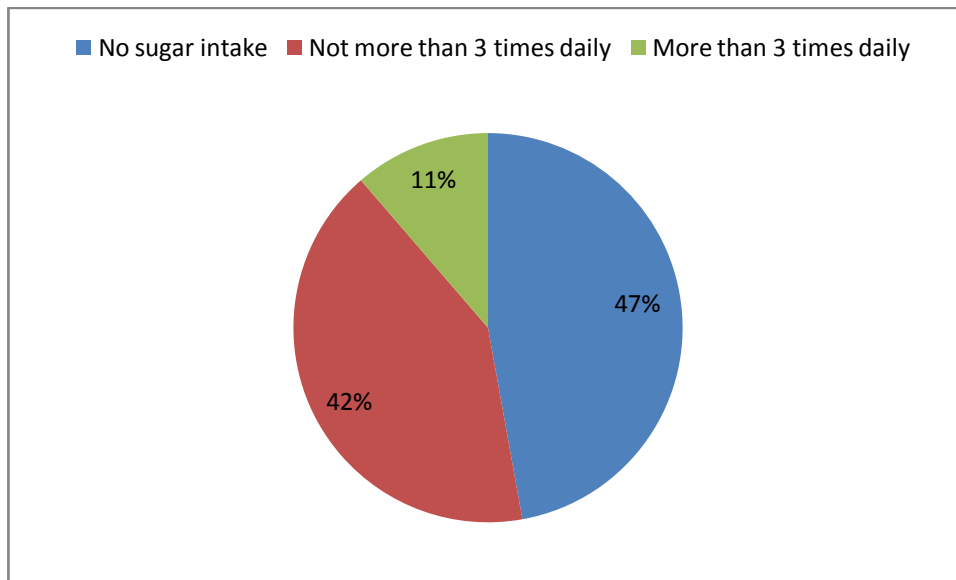


Figure 10: Daily sugar intake for the CP group

6.5 Previous dental experience of the CP group

Only 7 (13%) of them had previous experience in the dental office concerning fluoride application. Two of them, one in the permanent dentition's subgroup and one in the mixed dentition's subgroup had undergone dental treatment under general anesthesia.

6.6 Nutrition habits and oral status of the CP group

As it will be analyzed later, the CP patients due to the lack of adequate masticatory ability in several cases, they are occasionally or at frequent based ntheished by food provided in semisolid or liquid form or sometimes the food is retained more than the usual in the oral cavity of the individual before it is swallowed. Therefore, the type of the food was under question and there was found a statistically significant impact on the oral hygiene score (Table 6). The mean score of the OHI-S index was 1,5 (± 1)for both the individuals who were feed only with

semisolids or liquids and therefore had worse masticatory ability in comparison with the mean score ($0,7\pm0,5$) of the CP individuals who were able to eat all types of food.

Table 7: Mean differences between types of nutrition and score of OHI-S

Type of nutrition	Mean score	\pm SD	P value
All types	0,657	0,048	*0,003
Semisolids/puree	1,460	1,00	
liquids	1,488	1,03	

Tested by ANOVA

Moreover the caries prevalence seem to be affected by the type of the nutrition in a statistical significant way. (Table 8)

Table 8: Mean differences between types of nutrition and score of DMF index

Type of nutrition	Mean score	\pm SD	P value
All types	2,68	1,45	*0,034
Semisolids/puree	4,14	2,54	
liquids	5	4,24	

Tested by ANOVA

6.7 Brief comparison between the potential risk factors regarding caries prevalence and oral hygiene in CP group

Table 9: Comparison among the factors under examination regarding caries prevalence

Factor	Significance
Social status	0,176*
<i>Mother</i>	0,521*
<i>Father</i>	
Brushing frequency	0,95±
Presence of seizures	0,531*
Sugar intake	0,281±
Type of CP	0,552*
Type of nutrition	0,034±

**t-test±ANOVA, p<0,05*

Table 10: Comparison among the factors under examination regarding oral hygiene scores

Factor	Significance
Social status	0,078*
<i>Mother</i>	0,51*
<i>Father</i>	
Brushing frequency	0,605±
Presence of seizures	0,156*
Type of CP	0,227*
Type of nutrition	0,002±

**t-test±ANOVA, p<0,05*

6.8 Drooling status of the CP group

In the CP group under examination 13 individuals had more than 2 drooling score. 6 in the primary dentition's subgroup, 5 in the mixed dentition's and 3 in permanent group. The total percentage of prevalence of drooling in the group is 23%. (Figure 11)

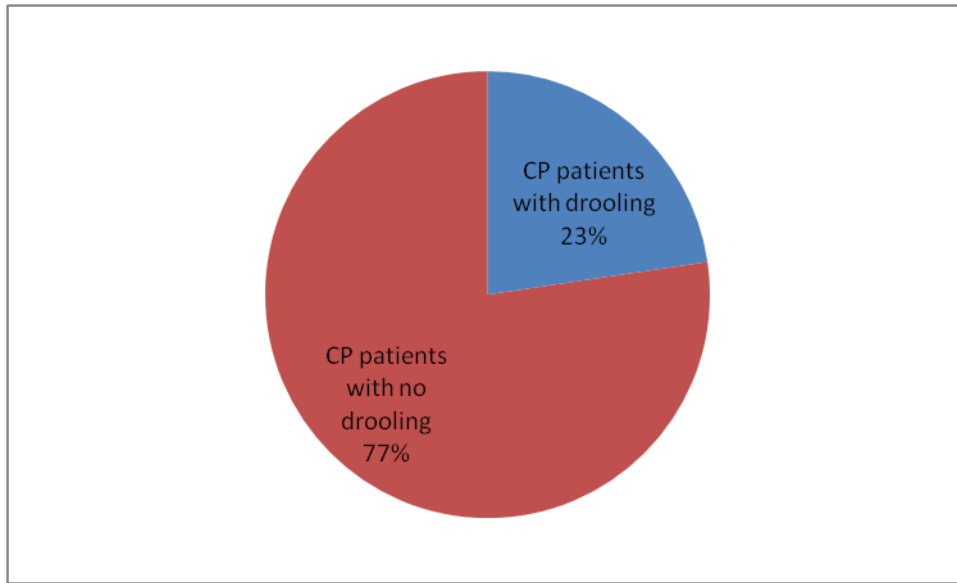


Figure 11: Drooling prevalence in the CP group

Furthermore, 2 of the individuals have undergone treatment with Botilun toxin and physiotherapy and their drooling scores are inside the acceptable levels (drooling score 2, no signs of drooling and VAS score 0) and considered as CP individuals withno drooling from now on. Also, 3 of the CP patients with symptoms of drooling, two with physiotherapy and one with reflexion therapy have managed to reduce their drooling situation and obtained drooling scores of 4, 5 and 6 respectively.

6.9 Drooling and its effect on caries prevalence and oral hygiene.

There was not any statistically significant correlation found between drooling scores caries prevelance and oral hygiene. (Table 11) However it can be said that the higher drooling scores increase the oral hygiene scores even though in a not statistically significant way.

Table 11: Spearman’s correlation coefficient (R_s) values between drooling scores and DMF and OHI-S scores

	R_s	p value
DMF score	0,07	0,614
OHI-S score	0,164	0,242

$p < 0,05$

6.10 Drooling status of the CP individual and the burden on the caregiver

With the use of VAS scale there can be assessed the burden of the drooling status regarding the caregiver’s/ family inconvenience. By comparing the VAS scores’ relationship with oral hygiene we can find if the severity of drooling can affect the caregiver’s motive about maintaining in the best way possible the individual’s oral hygiene. The results showed that there is a positive relationship between VAS score and OHI-S score (R_s : 0,114, checked by Spearman’s correlation coefficient test) which means that if the VAS score increases also the OHI-S does, confirming the consumption, but however, not in a statistically significant way (p value: 0,42).

6.11 Drooling status and seizures

In the study group there is a statistically significant higher prevalence of drooling in epileptic CP subgroup. (Table 12)

Table 12: Comparison for drooling scores among the epileptic and non-epileptic CP individuals

	Mean score	±SD	p- value
Epileptic CP	3,8	2,2	*0,004
Non-epileptic CP	2,4	1,2	

p<0,05, tested by t-test

6.12 Drooling status and type of CP

Also the type of CP is statistically not significant for the drooling score's outcome. (Table 13)

Table 13: Comparison for drooling scores among the CP individuals with spastic type of CP and non spastic

Type of CP	Mean scores	Deviation (±SD)	p-value
Spastic type	2.9	1,77	0,39
Non-spastic type (athetoid/ataxic)	2.3	1,06	

p<0,05, tested by t-test

7. DISCUSSION

7.1 Discussion of the aim, material and methods

The aim of the study was to evaluate the dental needs of CP patient in comparison with non-disabled population and also to evaluate their drooling status. Furthermore, the correlation between various factors and oral status (oral hygiene, caries prevalence, drooling) of the CP group were cross sectioned and investigated in order to draw attention to the causes of their increased needs for oral related health issues.

All the medical history was carefully asked in case there is any condition regarding caries activity or any special medication. The presence of seizures were also taken into account. It is stated that always seizures should be registered before making any dental plan because for CP children is an important factor causing general pain and toothache due to muscle spasm when there is spasticity. (Breau et al., 2003) The frequency of brushing, the frequency of inbetween meals and especially the sugar intake are important to define the risk factors for this group of individuals.(Chandna et al., 2011)

As it already referred before, it is demonstrated that often the dental need of special care patients is underestimated by both their carers and the dental profession and there is need of a system that will ensure that these people will be targeted as a group in particular need of preventive care, access for dental care, for care under general anaesthesia when needed, and not been neglected as dental patients.(Hennequin et al., 2000)

Oral health is often considered as a probable source of health inequalities in persons with neuromotor and mental deficiencies. The quality of the evidence base supporting this assumption is not high despite numerous studies reporting poor oral

health in patient groups with disabilities. (Hennequin et al., 2008) Many studies have no control group, use inappropriate indicators or report a partial evaluation of oral health. (Hennequin et al., 2008) Is therefore very important and essential to foster epidemiological and cross-sectional studies on prevalence and types of oral health conditions in infants, children, and adolescents with neurodevelopmental disabilities and other children with special health care needs in community and institutional settings, consider surveillance studies of certain groups of children with special health care needs and monitor important health benchmarks including immunizations, oral evaluations, and dental referrals. (Mouradian et al., 2001) Therefore, more cross-sectional studies with control groups are needed to be more accurate for the nowadays needs of dental patients with disabilities.

As it is vastly stated CP patients have a high prevalence of oral co-morbidity especially caries. (Santos et al., 2010) Food consistency, sugared beverages, and long term medications combined with oromotor dysfunction (Gangil et al., 2001) and difficulties with oral hygiene may explain the high incidence of caries in CP populations. (Freysleben et al., 2000; Sonis et al., 1997; Santos et al., 2009; Dos Santos and Nogueira 2005) In conclusion there is the need to evaluate the level of their dental needs, previous dental experience, to determine the risk factors for caries prevalence and the oral status regarding the presence of drooling for the CP individual to reassure they will be received the best preventive and treatment care from the dental professionals.

As it was calculated there was needed at least 40 patients for every group to evaluate the differences. We screened all the patients available that participate in physiotherapy and orthoses in Metin Sabanci Institute and a similar group of non-disabled people from a kindergarten, primary, secondary and high school. Patients that were uncooperative or their families did not consent were excluded from the study group. Therefore the subjects of the study were 106 in number consisted 2 groups and each of the group was similar in sex and age. The CP group (study group) consisted of 35 males and 18 females, aged 4 to 20 years old (mean \pm SD; 6 years 7

months \pm 3 years 5 months). (Figure 1) The nondisabled group (control group) comprised by 53 subjects aged from 4 years old to 19 years old (38 males and 15 females) with mean \pm SD; 6 years 9 months \pm 3 years and 1 month. The age range used is in agreement with other researchers' similar studies for CP individuals. (Dos Santos and Nogueira 2005; Ortega et al., 2007; Oredugba 2011; Santos et al., 2010)

The oral data were measured including the use of oral hygiene index (OHI-S) and DMFT-dmft scores both for study and control group. Specifically, for dental and oral assessment the subject's teeth examined visually and tactilely under artificial illumination, according to WHO (World Health Organization) procedures (WHO 1997); caries prevalence assessed using the Decayed, Missing and Filled (DMF/dmf) index for permanent and primary dentitions, respectively. Decayed teeth will be assessed only at frank cavitation, teeth with white spots lesions will be considered sound (Form 1). We chose the DMF index for having an easy but reliable way of registering dental caries experience, as the screening took place at the institution and not in a dental clinic. All of the available recent studies for CP patients regarding caries prevalence used the DMF index. (Dos Santos and Nogueira 2005; Dos Santos et al., 2002; Santos et al., 2010; Chandna et al., 2011)

For the same reason, the simplified oral hygiene index is used as there was need to assess the oral hygiene status of the CP persons in comparison with oral hygiene status of non-disabled persons. Oral hygiene is a reliable means for examine the ability of caregivers to maintain the oral hygiene of the CP individual. Specifically, the oral hygiene quantified with the simplified oral hygiene index (OHI-S) developed by Greene and Vermillion (Greene and Vermillion, 1964). The oral hygiene index is vastly used for measuring the oral hygiene in patients (DeStefano 1993; Kolawole et al., 2011; Ojahanon et al., 2013; Podshadley and Haley 1968; Silvinha et al., 2010). The simplified version of the hygiene index is also suggested as a reliable instrument and used in epidemiological studies. (Silvinha et al., 2010; Podshadley and Haley 1968) Dos Santos and Nogueira also in order to examine infantile reflexes and their

effects on dental caries and oral hygiene for CP patients, used the Simplified Oral Hygiene Index. (Dos Santos and Nogueira, 2005)

Controversy is existed on the ideal method for measuring drooling. (Yam et al., 2006) Techniques that require more complicated measurements are not easily tolerated from CP individuals and when it comes to the saliva quantification it can differ from day to day and might not be measured objectively. (Blasco 2002) Therefore, it is better to rely on the basic clinical estimation by caregivers. (Yam et al., 2006)

For the measurement of drooling in the CP group, it was assessed by two techniques. The first is about the caregiver and the burden created by the drooling, if any, in order to include this important and subjective parameter. Visual analog scale (VAS)—a questionnaire-based scoring system for severity of drooling. (Table 1) is used by studies measuring drooling both before and after treatment. This is a semiquantitative scale that will be marked from 0-10 from the chief caretaker, with the severity of drooling scaled as 10 meaning very severe and 0 no drooling. (To et al., 1999) (Table 1) To et al., and Wong et al., used the VAS score for assessing the effects of tongue acupuncture in drooling problems, followed by others also. (Jongorius et al., 2004; To et al., 1999; Yam et al., 2006; Wong et al., 2001). Others (Tahmassebi and Cruzon, 2003) used a more complicated in terms of special equipment and time-consuming method of quantify drooling by measuring the drooled saliva via special devices, as described by an old research. (Sochaniwskyj, 1982) In the case we wanted a fast but epidemiologically correct index, so the drooling score (sum of the drooling severity and drooling frequency) (Table 2) was used as it is proposed and used by similar researches. (Heine et al., 1996)

The statistical method in each case when analyzing was chosen appropriately and accordingly, regarding the variances' nature, distribution and behavior. The latest and accurate version of SPSS package was used.

7.2 Discussion of the results

For the cross-sectional part of the study, regarding caries prevalence, the mean scores for primary, mixed and permanent dentition accordingly were 3,3 5 and 4.2 for the CP group and 2,22 4 2,2 for the control (non-disabled group). The results showed moderate to high severity of activity (moderate DMFT 3-4, and high DMFT \geq 5). In all the dentitions the CP group has higher caries prevalence, especially in the mixed dentition where the difference was statistically significant. Overall the total DMF scores for the CP persons were higher and in a statistical significant way as it was expected confirming the initial hypothesis. (Table 3) The only limitation in the sample was the limited group for permanent dentition that was available, and it is considered that if there was a larger one, this is subgroup would be also statistically significantly increased.

The results are with agreement with other similar recent cross-sectional studies. (Folakemi 2011, Santos et al., 2010) Additionally, the high caries' activity found in this study is also similar to recent epidemiological studies concerning CP persons. (Alhammad and Wyne 2010; Chadna et al., 2011; Dos Santos et al., 2002)

Specifically, Santos et al., also found statistically significant differences in mixed dentitions between the control and the CP group (aged similar to this project's age groups) and in total scores. (Santos et al., 2010) Their results for DMF scores were closed to ours, 2,3 and 4 for primary, mixed dentition of the CP group accordingly. However they found higher scores for permanent dentition (7.6) in comparison with us, probably because of the larger group of CP with permanent dentition they screened. Moreover, Dos Santos et al., also, some years earlier, found higher DMF scores for 65 CP patients in comparison with a similar normal group in both mixed and permanent dentitions, but only in permanent dentition was significantly higher. Therefore they suggest they did not conclude if CP patients are overall at higher risk because they examined single variables and only a multivariable analysis can establish this. (Dos Santos et al., 2002) The total score of

the group for DMF index was 4,2 in agreement with the recent similar study of Santos et al., in 2010 who find a score of 4,8 in 65 CP non institutionalized like the sample and with Dos Santos and Nogueira in 2005, earlier, who also in 124 non institutionalized found 2,5, 5,86, and 5,34 for primary mixed and permanent dentitions. (Dos Santos and Nogueira 2005; Santos et al., 2010) Abanto et al., however, in 2014 found lower total DMF score (2,06) for 60 CP children but with shorter age range than ours (6-14 years old, mean age: 9,13). (Abanto et al., 2012) Chandna et al., also found a lower DMF score (3) in a very recent cross-sectional study, but their study group was smaller (25) and aged just from 6 to 10 years old. (Chandna et al., 2011)

The role of the oral hygiene is already discussed for the importance in CP individual's life who are dependent of their caregivers' ability to maintain oral hygiene for them. (Abanto et al., 2012, Santos et al., 2010) Accordingly to many parents there is difficulty in properly brushing their children's teeth and this results in an unsatisfactory oral hygiene. (Rodrigues dos Santos et al., 2003) They are dependent and therefore defining their needs about having the optimal oral health which is closely related to oral hygiene is an important field for research.

There a lot of limitation concerning maintaining oral hygiene in cerebral palsy individuals as it is already discussed and it will be discussed below. The a priori identification of individuals at high risk of caries would be of considerable importance in allocating resources to caries prevention. (dos Santos et al., 2002) The risk factors should be investigated and determined in order to prevent the incidence of caries in every individual as it will be in the case also.

Comparing the groups for the oral hygiene, the CP group had significantly higher oral hygiene scores in both primary and mixed dentitions' subgroups. (0,75, 0,75 in comparison with 0,35 and 0,37 of the control group) Also the total score was significantly higher for the CP group (0,79 and 0,248 study and control group accordingly). Only the group of the permanent dentition was higher but not

significantly again because of the limitation of the sample available. This is in agreement with Guare and Campioni (2003) who also observed that, the mean values for the debris index, OHI-S, and gingival index were higher in the children with CP than in their control group. (Guare and Campioni, 2003) Dos Santos and Nogueira found 2,22, 2,23 and 2,22 for each dentition higher than the scores but with a larger sample. (Dos Santos and Nogueira, 2005) Rodrigues dos Santos et al., also by using the plaque index found significantly higher scores for permanent dentition for CP patients comparing with a control group, (Rodrigues dos Santos et al., 2003) Alhammad and Wyne also found that the CP patients that screened with same method like thes, had not adequate oral hygiene, and only the 5,7% of the sample had good hygiene (less than 1,3 score)and most of them (71,5%) had scores around 1.3 to 3, higher than the total score, but close to the permanent dentition subgroup's score, however, considering their sample was larger and narrower for age range because of its epidemiological nature (Alhammad and Wyne,2010) Orebugda in 2011 found also higher OHI-S scores for their CP group in Nigeria in comparison with the normal group but with higher scores than thes. (Orebugda 2011) Therefore, more cross-sectional studies are needed, especially for every country or region separately to determine the differences between disabled and non-disabled groups about their ability to maintain optimal hygiene.

In the study based on the families' statement the brushing frequency was adequate and might explain the good to fair and not poor total oral hygiene status in the CP group. Only 17% did not brush at a daily base and most of them did brush at least 1 or two times daily at the time of the examination. Chandna et al., in a smaller sample found that only five children (16%) brushed twice daily. (Chandna et al., 2011)

The importance of oral hygiene is proved as there is a correlation with caries incidence as also proved in the study. The statistical analysis showed statistically significant correlation, ($p=0,000$, $R_s=0,478$ checked with Spearman's coefficient correlation value) between the DMFT score and oral hygiene score. Alhammad and

Wyne also found correlation between the DMFS and OHI scores in their study. (Alhammad and Wyne, 2010) Oral hygiene practices are important to be registered in order to be optimized in all people. (Kolawole et al.,2011)

The socioeconomic status of the family on the oral health of a child is well analyzed and discussed but mainly about healthy children. (WHO 1997; Du et al., 2010) More studies are needed to define the influence of the social or economic status of the family for the life of the disabled in order to determine their oral health-related quality of life (OHRQ). (Abanto et al., 2012) In the study we asked and analyzed the educational status as an index of social status and we discovered that the educational status of the mother affected more the DMF scores and oral hygiene than the father's but not in a statistical significant way. Abanto and his associates in a similar group, found that the educational level of the father was the factor the affected in a statistical significant way the OHRQ of their CP patients (Abanto et al., 2012)

The type of CP can be also a potential factor that influence caries prevalence or the oral hygiene. (Abanto et al., 2012) Given the different nature of every type about muscle capacity and muscle spasm intension (Ortega et al., 2007) there might different results among the individuals mainly related to the caregivers' success to achieve proper hygiene. In the study there are not statistically significant differences about oral hygiene, caries prevalence between the different types of CP. De Carnago and Artunes also in a study carried out in Brazil, the high caries prevalence was irrespective of type of CP. (De Carmago and Antunes, 2008) Abanto and associates when comparing the different levels of severity of CP, but not CP types, they do not find any impact on their oral health-related quality of life. (Abanto et al., 2012) Also Dos Santos and Nogueira do not find statistically significant differences between subgroups of spastic type of CP as their sample was limited to spastic type of CP children (Dos Santos and Nogueira, 2005) More studies are needed to define if the association, if any, among different types of CP and caries activity. For the oral hygiene the results were the same and there is lack of literature about comparing the

oral hygiene among the different types of CP or even severity. Only Dos Santos and Nogueira examined OHI-S scores among their CP patients and found also no significant differences between the subgroups of only spastic type of CP (quadriplegia, hemiplegia, diplegia). (Dos Santos and Nogueira, 2005)

It is stated that always seizures should be registered before making any dental plan because for CP children is an important factor causing general pain and toothache due to muscle spasm when there is spasticity. (Breau et al., 2003). For Abanto and associates there was relation between the presence of seizures and oral symptoms. (Abanto et al., 2012) The oral hygiene and the outcome in caries activity was not affected in the study by if the CP individual had seizures.

The brushing frequency and the sugar intake were less to be taken as an objective factor because we are mainly related to the family's statements. The frequency was good enough for brushing and did not affect the outcome. No significant differences were observed between CP that got brushed more. In this study, nearly all the subjects cleaned their mouths only once a day. Also like in other recent findings for other CP populations. (Oredugba 2011) These findings are hopeful and state the higher awareness of the families about their disabled members of the family. However, the sample was about families that are referring to Metin Sabanci Institute for ctheses and physiotherapy and therefore their high interest is generally taken for granted. The most important factors in the maintenance of good oral hygiene are the frequency and effectiveness of tooth brushing and ability to control the masticatory musculature, which are all deficient in this population. Parents and caregivers need to be advised on oral health issues concerning themselves and their wards, and that these individuals require supervision despite their age. Many of these subjects will benefit from assistive devices such as electric toothbrushes and toothbrushes with large handles. (Oredugba 2011) More studies are also needed to evaluate the effectiveness of tooth brushing by caregivers for CP patients or generally disabled groups. (Yitzhak et al., 2013) The same authors checked the

effectiveness of triple-headed toothbrush compared to single-headed one and found it more effective for nurses that brushed institutionalized CP individuals. (Yitzhak et al., 2013) The sugar intake was not excessive as already discussed and therefore it can be assumed that these individuals have generally controlled nutrition by their caregivers' because of their difficulty to masticate. Only the 11% had more than 3 times daily consumption of sugary products or soft drinks, there as not significantly higher caries prevalence in the group. De Carnago and Antunes found a significant impact in their CP group caries prevalence for the sugar intake. (De Carnago and Antunes, 2008)

The nutrition habits of the CP palsy individuals are more important and vastly discussed in the literature. Reilly et al., in their study in order to determine the prevalence and nature of feeding problems and oral motor dysfunction they very young CP patients and found that the majority of them had oral dysfunction and did not have regular nutritional intake. (Reilly et al., 1996) Their results are mainly important for the spastic type of CP because of the limited available sample for ataxic and athetoid CP children. More than 90% had feeding problems and the 70% had difficulty in chewing solids. This concludes in more consumption of liquids and semisolids whose difficulty in feeding for the mothers is less. (48%, 35%) Also the more the severity of the CP, the more there is oral dysfunction. (Reilly et al., 1996) Oromotor dysfunction is associated with difficulties with oral hygiene may explain the high incidence of caries in CP populations. (Freysleben et al., 2000; Sonis et al., 1997; Santos et al., 2009; Dos Santos and Nogueira 2005) Also, food consistency combined with oromotor dysfunction can be a risk factor (Gangil et al., 2001; dos Santos et al., 2002) The oral dysfunction can be also related with daily oral hygiene. (dos Santos et al., 2002)

In the study the main risk factor for oral hygiene and caries was the nutrition type. Food consistency combined with oromotor dysfunction can be a risk factor (Gangil et al., 2001; dos Santos et al., 2002) The mean score of the OHI-S index was 1,5 (± 1) for both the individuals who were feed only with semisolids or liquids and

therefore had worse masticatory ability in comparison with the mean score ($0,7\pm 0,5$) of the CP individuals who were able to eat all types of food. Also the individuals feed by liquids and semisolids or puree had DMF scores 5 and 4.18 respectively. More research should be conducted for the association of food type and caries prevalence as a risk factor as most of the studies available deal with other factors such as microbiological factors or capacity of saliva, socioeconomic status, strain of the caregivers but do not take into account the dietary habits which are also important for the optimal preventive plan of these patients. (Santos et al., 2010)

The prevalence of drooling related to CP is about 10% and it is referred as severe interfering with everyday activities. (Blasco and Allaire, 1992). Others estimate it from 10 to 37%. (Ekedhal 1974, Heyning et al., 1980) In the study the 23% of the study group has drooling signs and none of the control group's patient as expected. Therefore, the drooling should be established as one of the main problems considering oral health-related quality of life for CP individuals. This study's prevalence is inside the estimation of the literature. (Ekedhal 1974, Heyning et al., 1980)

Furthermore, 2 of the individuals had undergone treatment with Botulin toxin and physiotherapy and their drooling scores were inside the acceptable levels (drooling score 2, no signs of drooling and VAS score 0) and considered as having no drooling. Also, 3 of the CP patients with symptoms of drooling, two with physiotherapy and one with reflexion therapy have managed to reduce their drooling situation and obtained drooling scores of 4, 5 and 6 respectively.

These treatments are not in the common dental practice however, the dentist should be familiar to them. The treatment of drooling is a multidisciplinary work both from the doctor, the physiotherapist and the dentist. A number of therapies to treat drooling have been advocated but consideration should first be given to correcting any of the aggravating features which if eliminated or altered would reduce drooling. For example, because saliva flows with gravity, a head down

posture will exacerbate the situation. Significant dental disease will result in an increased salivary flow and thus should be treated. Likewise, severe malocclusions are seen in many disabled children and as long as an anterior open bite or large overjet is present the child will find it impossible to obtain a lip seal. (Nunn, 2000) In that spirit there should be a good preventive work from the dental professionals to decrease the dental disease and enhance the CP individuals' quality of life.

Surgery to control drooling, the final treatment option, is recommended in the following situations. (Crysdale, 1989) Firstly, in patients where there is persistent drooling of a moderate degree and where conservative management options have failed; in patients who experience profuse drooling and in whom there is a history of failed or limited success by more conservative means; and in patients with moderate drooling where cognitive development is limited and where conventional conservative management strategies would fail because of poor cooperation by the patient. Surgery to control drooling falls into three broad groups. The first comprises procedures designed to reduce the amount of saliva produced, for example transtympanic neurectomy, salivary gland excision and blocking the flow of saliva into the mouth as in parotid duct ligation. The second comprises procedures designed to re-route the site where saliva enters the pharynx, for example parotid duct ligation, bilateral submandibular gland relocation and, more recently, a combination of submandibular gland duct relocation and sublingual gland excision (Crysdale, 1989) A third option that combines the techniques of reducing salivary flow and re-routing the flow has also been tested. (Nunn, 2002)

The botulinum toxin is vastly used and it is quite successful for CP patients. The ones treated in that way in the study had the most radical differences. It is also suggested by authors that its injection in the glands in low dose can reduce drooling while maintaining oral health (Wu et al., 2011) More studies are needed for future for designing the optimal dose, ensure its use and concerning there would be no consequences in salivary flow rate and oral health. Others are seriously concern

about its side-effects and do not recommend it until it is totally proved safe. (Blasco 2002) Another study has shown that children with CP following sialodochoplasty have increased risk of dental caries when compared with those treated nonsurgically for drooling. (Hallet et al., 1995) Although no caries predictors were identified, alterations to the caries-protective role of saliva are considered the likely cause. (Hallet et al., 1995) Children who undergo this procedure should receive intensive pre- and postsurgical preventive dental therapy. The dental professional should be aware about any complication of this treatment and be informed about its general characteristics when asked and consult the family of the CP patient. For any invasive treatment like this, especially the surgical ones, the dentist should do strictly follow ups and be able to locate any post-operative saliva deficiency that can affect the total oral health and take appropriate preventive measurements. (Nunn,2000)

Therefore less invasive but closer to the dental profession treatments are available. Among the non-surgical methods are the bio-functional appliances and physiotherapy (Hussein et al., 1998) In the study two of CP patients both of them in the mixed dentition group were consulted to have physiotherapy and their drooling scores were lower than the previous years. The dentist should be familiar and in place to consult for appliances that can non-invasively help the CP patients in controlling their motor orofacial disabilities.

The biofeedback appliances are orthopedic and applying pressure to the chin or by performing anti-drooling classes with various means in order to teach the child to understand when drools. They have showed to reduce up to 73% of the saliva drooled. (Harris and Dignam, 1980) The bio-functional devices that are acrylic appliances with stimulating palatal plate or mouth vestibular brace are used to stimulate oral musculature either with the tongue or with the lips. (Figure 4.5) The flanges of the device stimulate the cheeks the lips and there has been shown a reduction up to 67% in drooling by improving the swallowing. (Crysdale et al., 1985) Much work carried out in South America and Germany has appeared in the literature on the use of this oro-facial regulation therapy (Castillo-Morales, 1978;

Hoyer and Limbrock, 1990) These appliances rely on modifications to palatal acrylic appliances for their action. Acrylic 'buttons' and beads are added to standard acrylic base plates and act as the active components in the stimulation of different areas of the intra- and circum-oral musculature (Figures 5 and 6). On occasion, further modifications are required to compensate for missing teeth (Crysdale, 1991). In children with hypotonic circum-oral musculature and protruding tongues, as is commonly seen in Down and Moebius syndrome patients, such an appliance encourages a retrusive positioning of the tongue as well as the formation of a lip seal. Hoyer & Limbrock (1990) reported successful treatment using this method in two thirds of 74 children aged between 6 weeks and 8 years. No data are given to support the conclusion, only the view that the oro-facial hypotonic symptoms were significantly reduced, thus permitting improvements in oral function and expression. Whilst some authors have not found a relationship between drooling incidence and the type of cerebral palsy (Lespargot et al., 1993), others feel that the type of defect may influence the design of the appliance, because the physical manifestation of the condition differs between, for example, the athetoid and the spastic forms of the condition (Avalle and Limbrock, 1987).

Much of the literature on palatal training aids presents anecdotal results only. The paper by Limbrock *et al.*, (1990), however, gives results for 68 cerebral palsy patients, for whom there was a 72% success rate in those with severe drooling. No criteria are given for either the assessment of drooling or the outcome of treatment nor was a control group used. Fischer-Brandies *et al.*, in 1987 reported on the successful treatment of 71 children with cerebral palsy. They detailed the modifications to be made to the palatal plates depending on the type of cerebral palsy. In addition to the training plates, one-third of the children underwent special oral and facial physiotherapy. A detailed neuropaediatric assessment was made at the beginning and on completion of active treatment, with a mean observation time of 15 months. The authors reported an improvement in at least half of the cases using the assessment in spontaneous tongue position, coordination of tongue movement, food

intake, speech development and drooling. There had been little improvement in spontaneous lip posture and mouth open posture in most cases. Most of the studies using oro-facial regulation therapy conclude that the features of oral dysfunction can often be improved but seldom normalized. In addition, it would appear that in some studies there is evidence that if therapy is not instituted before the child is 4 years old, rejection of the plate may occur and treatment will be unsuccessful. (Nunn, 2000)

The conclusion from these studies would appear to be that cerebral palsied children certainly differ from normal children in their frequency of subconscious swallowing as well as in utilizing an inefficient and uncoordinated swallow. These findings would seem to indicate that the use of behavioral treatment methods to increase swallowing frequency coupled with some form of oral motor therapy to facilitate lip closure and coordinated swallowing are the treatment approaches to be adopted (Harris and Purdy, 1987). Competent management of the patient who has a drooling problem will relieve not only much psychological and physical distress but is also likely to contribute towards the better integration of affected people within their own social milieu in the absence of this stigmatizing feature. Dentist or pediatric dentist should be aware of the possible options and coordinate with the multidiscipline team of doctors-neuropediatricians, physiotherapists for the optimum result and oral health concerning CP individuals.

Drooling can affect in various aspects the life of the individual as it is already discussed. For a dental professional it is very essential to evaluate any effects of the drooling situation concerning oral health and take preventive measures. Hegde et al., (2008) reported that, drooling may not predispose the individual to dental caries but individuals with drooling have a poorer oral hygiene score than those without. Also it is already proved that drooling is not hypersalivation, so the saliva has normal flow rate when compared to individuals who do not drool. (Tahmassebi and Cruzon, 2003; Erasmus et al., 2009)

In the study the VAS score (as a subjective index for the burden of the drooling to the caregiver) and its influence is investigated regarding the oral hygiene and the caries prevalence. The results show that there is a positive relationship between VAS score and OHI-S score ($R_s: 0,114$, checked by Spearman's correlation coefficient test) which means that if the VAS score increases also the OHI-S does, confirming the consumption, but however, not in a statistically significant way (p value: 0,42). Authors have extensively analyzed the impact of the burden of the caregivers to the quality of life for CP individuals. (Santos et al., 2010) The same authors proved during their research their hypothesis about correlation of caries prevalence and burden of care, however, claimed the need for more research (Santos et al., 2010) In the study, the index is limited just to the VAS score. More research is required on the subject and the results will be very important for the quality of life (QOL) of the CP individuals.

There is not any statistically significant correlation found between drooling scores caries prevalence and oral hygiene. (Table 11) However it can be said that the higher drooling scores increase the oral hygiene scores even though in a not statistically significant way. Also, Hedge et al., in 2008, in the only available research for the effects of drooling in caries prevalence and oral hygiene, using the same index with the study, found that no significant difference in the dental caries status, orthodontic findings or the debris component of the Oral Hygiene Index of individuals who drool saliva and those who do not. (Hedge et al., 2008) There is need for future research on that field in order to underline the importance of treating drooling in disabled patients not only as a matter of quality of life, generally, but also as a matter of oral health related quality of life. In the same spirit, Dos Santos and Nogueira have already investigated the influence of other infantile reflexes on dental caries and oral hygiene and found that the higher the severity of the disease is, the more prominent the reflexes are and so the risk for oral diseases. (Dos Santos and Nogueira, 2005)

The presence of seizures has found to be a risk factor for more extensive drooling in the CP patients. It increased significantly the drooling score as it is already discussed in the results. It is already known that drooling have multiple etiology. One of the situations related is also epilepsy. (Erasmus et al., 2009)

The type of the CP can also be a factor that affects the drooling prevalence. Erasmus et al., with the examination of 100 CP children from 3 to 19 years old, have shown that there is more intense drooling for the dyskinetic subgroup. (Erasmus et al., 2009) However, Reilly et al., by examining 49 CP children did not find any differences between the spastic subgroup and the other two groups regarding orofacial motor disorder. (Reilly et al., 1996) In the results, there are no significant differences in the subgroups. However, for this specific matter larger and more research is required.

All in all, all office visits for children with cerebral palsy should be anticipated as requiring extra time and scheduled as such. The regular schedule of visits for well-child care and anticipatory guidance will require supplementation with additional periodic chronic condition management visits. It is the responsibility of the medical and dental home to ensure that routine preventive care goals are met and additional preventive care requirements associated with cerebral palsy are fulfilled in a timely way. A written care plan should be developed together with the child and family and reviewed at each office encounter. Most children with cerebral palsy live at home with their families, attend regular classrooms at their neighborhood schools, and participate in a variety of natural community activities. As adults, most continue to live in community settings, but one third live at home with their parents, whose ability to continue caregiving may decrease as they age. Twenty percent of adults with cerebral palsy are ambulatory, and 40% can walk with assistance; the remaining 40% are nonambulatory. (Cooley. 2004)

The horizon of opportunity for individuals with cerebral palsy has continued to expand with improvements in health care, developmental and educational services,

and support for individuals and families in community settings. The primary care medical and dental home is an organizing force for the provision of appropriate preventive health care and for the integration of care into the fabric of other important supports and services. (Cooley, 2004)

8. CONCLUSIONS

1. The CP group of the study has statistically significantly higher caries prevalence than the control group of the non-disabled individuals. The mean DMFT of the study group score is 4,2.
2. The CP group of the study has statistically significantly higher oral hygiene scores than the control group with mean score 0,97.
3. The social status of the family/caregivers, the brushing frequency, the presence of seizures and the type of CP does not affect in a significant way the caries prevalence and the oral hygiene score.
4. The type of the nutrition (liquid, semisolids or solids/all types) has a significant correlation with both the oral hygiene and the caries prevalence of the CP group.
5. The Drooling prevalence is 23% in the CP group.
6. Statistically the drooling does not affect the caries prevalence and the oral hygiene of the CP group in a significant way.
7. The presence of seizures increases the drooling prevalence in the study group in a statistically significant way.
8. CP individuals have increased need for prevention and dental treatment in comparison with general population.
9. The conduction of a multidisciplinary team for the cerebral palsy individuals is very essential for their quality of life.

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10. APPENDIXES

App 1

FORM 1

HASTA BİLGİLENDİRME FORMU

ARAŞTIRMA PROJESİNİN ADI

‘ Serebral Palsili Bireylerde Oral Hijyen, Diş Çürüğü ve Artmış Salya Akışının İncelemesi’

Araştırmanın yürütüleceği kuruluş:

Marmara Üniversitesi Dişhekimliği Fakültesi, Pedodonti Anabilim Dalı

Bu çalışma için aklınıza takılan soruları aşağıda ismi, adresi geçen araştırmalardan öğrenebilirsiniz.

Sorumlu Araştırmacılar:

Prof. Dr. İlknur TANBOĞA

Marmara Üniversitesi Diş

Hekimliği Fakültesi

34365 Nişantaşı/Şişli/İSTANBUL

0 (212) 231 91 20

itanboga@marmara.edu.tr

Dt. Vasiliki TZİFA
Marmara Üniversitesi Diş Hekimliği Fakültesi
34365 Nişantaşı/Şişli/İSTANBUL
0 (212) 231 91 20
vasiatzifa@gmail.com

Araştırmayı hazırlayan kuruluş:

Bu araştırma Marmara Üniversitesi Dişhekimliği Fakültesi, Pedodonti Anabilim Dalı'nda görevli olan Prof. Dr. İlknur TANBOĞA, ve Dt. Vasiliki TZİFA tarafından hazırlanmıştır.

Amaç:

Bu çalışmanın amacı; serebral palsili ile benzer yaş ve cinsiyetteki sağlıklı bireyler arasındaki tükürük akışı, diş çürükleri ve ağız hijyeni açısından farklılıkları araştırmak ve tedavi ihtiyacını belirlemektir..

Bu araştırmaya katılmak için niçin seçildiniz?

Serebral palsili hastalar, çürük oluşumu bakımından yüksek risk altındadır. Gelecekteki çürük oluşumunun önlenmesi için nedenlerinin erken tesbit edilmesi ve tedavi planlamalarının yapılması, oral hijyenin iyileştirilmesi, artmış tükürük akışı açısından ebeveynlerin bilgilendirilmesi gerekmektedir. Çocuğunuzun serebral palsili olması sebebiyle bu çalışmaya katılması uygun görülmüştür.

Arařtırmada kullanılacak yöntem:

Arařtırmada ařađıdaki basamaklar sırasıyla incelenecektir.

Çocuđunuzun klinik muayenesinin yapıldıktan sonra sizlere sonuçlar ile ilgili bilgi verilecektir.

Arařtırmaya katılmakla meydana gelebilecek yan etkiler ve olumsuzluklar:

Çalıřma sırasında gelişebilecek herhangi bir komplikasyon bulunmamaktadır.

Arařtırma sürecinde dikkat edilmesi gereken konular:

Arařtırma esnasında ,takip sürecinde oluşabilecek komplikasyonlar en aza indirebilmek ve arařtırmanın etkinliğini dođru deđerlendirebilmek için ađız temizliğine ve beslenmeye dikkat edilmesi gerekmektedir.

Sizlerle yapılan ,ve belirttiđiniz konularda dođru hatırlayamadıđınız veya anlayamadıđınız konuları hiç çekinmeden doktorunuza söylemeniz çalıřmamızın dođru verilere ulaşmasında önemli bir yer tutmaktadır.

Randevulara belirtilen zamanlarda gelmeye özen göstermeniz ve belirli aralıklarla yapılacak olan takiplerde devamlılıđınız yapılan işlemlerin çocuđunuza yarar sağlayabilmesi ve çalıřmamızın başarısı açısından oldukça önemlidir.

Ayrıntılı bilgi çocuđunuza Dt.Vasiliki TZİFA tarafından, çocuđunuzun en iyi anlayabileceđi tarzda verilecektir.

Arařtırmadan beklenen faydalar:

Serebral palsili hastalarda, oral hijyendurumu, çürük riski ve tükürük akışının şiddetinin erken belirlenmesi ; dođru oral hijyen alışkanlıkları ve beslenme

açısından hastanın bilgilendirilmesi ve mevcut hastalıkların erken teşhisi ve tedavisi açısından önem taşımaktadır.

Gizlilik

Araştırma yakatılan bireylerin isimleri gizli tutulacak ve kendi rızası olmadan açıklanmayacaktır.

Araştırmacı;

Ad, Soyad:

Tel:

e-mail:

App 2

Onam Formu

Proje adı:

‘Serebral Palsi’ li Bireylerde Oral Hijyen, Diş Çürüğü ve Artmış Salya Akışı
İncelenmesi’

Araştırmaya ait hasta / kişi numarası:

Üniversite hastanesi protocol numarası:

Araştırmacı adı:

Marmara Üniversitesi Diş Hekimliği Fakültesi, Pedodonti Anabilim Dalı Araştırma Projesi Bilgilendirme yazısını okudum ve anladım. Sorularına Dt. Vasiliki Tzifa tarafından beni tatmin eden cevaplar verildi. Adı geçen projeye kendi rızam ile hiçbir baskı altında kalmadan katılmayı kabul ediyorum. İstedğim anda çalışmadan çıkabileceğim ve bunun normal tedavi sürecini etkilemeyeceğini, çalışmadan kendi isteğimle çıkmam halinde tıbbi ve hukuki haklarımın saklı olduğunu biliyorum. Araştırma süresince herhangi bir ödeme almayacağımı biliyorum ve kabul ediyorum.

Hasta:

Tarih

İmza

Velayet ya da vesayet

Tarih

İmza

Bulunanlar için veli veya vasi Tarih

İmza

Onam ve açıklama yapan

Tarih

İmz

Appendix 3

FORM 2

Patient's form

1. Name- Surname:

2. Date of Birth:

3. Telephone number-Adr:

4. Father's occupation:

5. Father's level of education:

6. Mother's occupation:

7. Mother's level of education:

8. Medical history: Cardiovascular problems: YES NO explanation:

Respiratory problems: YES NO explanation:

Endocrinological problems: YES NO explanation:

Hormonal problems: YES NO explanation:

Malignant diseases: YES NO explanation:

Epilepsy: YES NO explanation:

Underwent surgery, in hospital: YES NO explanation:

Under constant medication: YES NO explanation:

For patients diagnosed with cerebral palsy:

Type of CP: 1. spastic 2. ataxic 3. athetoid

DIET HABITS

11. In between meals food intake: YES NO

12. Daily frequency: 0 1-3 More than 3

13. Sugar intake (sweets, soft drinks) daily frequency: : 0 1-3 More than 3

14. Type of food intake (for cerebral palsy patients) :1. puree 2. semisolids3. solids4. liquids (drinking from a cup) Explanation:

BRUSHING HABITS/ FLUORIDE ADEQUACY

13. Does the patient brush or being brushed: YES NO

14. Use of fluoridated toothpaste: YES NO

14. How many times daily: 0 1 2 3

15. At what age (in years) did the patient start brushing: 1 2 3 3-46 Not yet

16. Use of fluoride supplements: YES NO

17. Dosage and frequency of supplements (if any):

DENTAL EXAMINATION

	87	6	5	4	3	2	1	1	2	3	4	5	6	7	8		
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

5 4 3 2 1 1 2 3 4 5

<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
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<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8		

DMFT: D: M: F: Total:

Dmft: d: m: f: total:

ORAL HYGIENE EXAMINATION

Debris

	Right Molar		Anterior		Left Molar		Total	
	Buccal	Lingual	Buccal	Lingual	Buccal	Lingual	Buccal	Lingual
Upper								
Lower								

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

Calculus

	Right Molar		Anterior		Left Molar		Total	
	Buccal	Lingual	Buccal	Lingual	Buccal	Lingual	Buccal	Lingual
Upper								
Lower								

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

Oral Hygiene Index = Debris Index + Calculus Index=

DROOLING EXAMINATION

Extraoral drooling signs: YES NO

VAS score:

Drooling severity:

Drooling frequency:

Drooling Score:



TÜRKİYE SPASTİK ÇOCUKLAR VAKFI

Prof. Dr. Hıfzı Özcan Cad. Tel +90 850 220 07 07 | Web tscv.org.tr
No:8 Ataşehir - İstanbul Faks +90 850 220 07 08 | Email info@tscv.org.tr

Sayı : TSCV.200.014.015
Konu : Tez Çalışması Hk.

14.01.2014


Marmara Üniversitesi
Diş Hekimliği Fakültesi
Pedodonti Anabilim Dalı Başkanlığı'na


Sayın Prof. Dr. İlnur Tanboğa;

11.12.2013 tarihli yazınız ile yapmış olduğunuz talebiniz değerlendirilmiş olup, Special Care In Pediatric Dentistry Master Programında öğrenciniz olan Vasiliki Tzifa'nın "Serebral Palsili Bireylerde Oral Hijyen, Diş Çürüğü ve Artmış Salya Akışının İncelenmesi" başlıklı tez çalışmasının Özel Metin Sabancı Özel Eğitim Rehabilitasyon Merkezinde yapması uygun görülmüştür.

Çalışmanın sonuçlarının bir sunum yapmak suretiyle uzmanlarımızla paylaşılmasını bilgilerinize sunarız.

Saygılarımızla,


Altan Edis
İcra Kurulu Başkanı


Nigar Evgin
Genel Direktör

Dağıtım :
- Özel Eğitim Rehabilitasyon Merkezi Müdürlüğü

App 5

T.C.
SARIYER KAYMAKAMLIĞI
Recaizade Ekrem İlk-Ortaokulu Müdürlüğü

05/06/2014

MARMARA ÜNİVERSİTESİ DIŞ HEKİMLİĞİ FAKÜLTESİ DEKANLIĞINA

Okulunuz Anabilim Dalında görev yapan Dt. Vasiliki Tzifa 05/06/2014 tarihinde ilkokul öğrencilerine dış taraması yapması uygun görülmüş olup bir sakınca görülmemiştir. Bilgilerinize arz ederim.


İsmail Turgay ERTÜRK
Okul Müdürü V.



İstinye Devlet Hastanesi Arkası
Dr.Nihat Reşit Sok. No:1
İstinye-SARIYER/İSTANBUL

Telefon : 0 212 277 56 72
Faks : 0 212 -229 40 51
e-posta : recaizadeekremk12@hotmail.com

11. ETHICS COMMITTEE APPROVAL



T.C.
MARMARA ÜNİVERSİTESİ
Sağlık Bilimleri Enstitüsü
Girişimsel Olmayan Klinik Araştırmalar Etik Kurulu

PROJENİN ADI: Evaluation of Drooling, Dental Caries and Oral Hygiene in Cerebral-Palsied Individuals
PROJE YÜRÜTÜCÜSÜ: Prof.Dr. İlknur TANBOĞA
PROJEDEKİ ARAŞTIRICILAR: Vasiliki TZİFA
ONAY TARİHİ VE ONAY SAYISI: 23.12.2013-8

Sayın Prof.Dr. İlknur TANBOĞA

127 protokol nolu "Evaluation of Drooling, Dental Caries and Oral Hygiene in Cerebral-Palsied Individuals" isimli projeniz Enstitümüzün Girişimsel Olmayan Klinik Araştırmalar Etik Kurulu tarafından incelenmiş ve etik yönden uygunluğuna karar verilmiştir.

F. Arıcıoğlu.
Prof. Dr. Feyza ARICIOĞLU
Komisyon Başkanı

İnci Alıcan
Prof. Dr. İnci ALİCAN

Prof. Dr. Serap AKYÜZ

Levent Kabasakal
Prof. Dr. Levent KABASAKAL

Prof. Dr. Aysel PEHLİVAN

Nefise Bahçecik
Doç. Dr. Nefise BAHÇECİK

Hakkı Arıkan
Doç. Dr. Hakkı ARIKAN

Doç. Dr. Asım CİNGİ

Bınar Ay
Prof. Dr. Bınar AY

Yrd. Doç. Dr. Murat ÇEKİN

Yrd. Doç. Dr. Zübeyir SARI

Yrd. Doç. Dr. Tolga GÜVEN



Marmara Üniversitesi Göztepe
Kampüsü Sağlık Bilimleri
Enstitüsü 34688 Kadıköy /
İSTANBUL

0 (216) 414 44 23/12 (Faks)
0 (216) 414 44 23

saglik.ogrenci@marmara.edu.tr
<http://saglik.marmara.edu.tr>

Ayrıntılı bilgi için:

12. BIOGRAPHY

I was born in Irakleio in Greece in 1987. I graduated from high school of Sitia Crete in 2005. I attended the Dental School of Aristotle University of Thessaloniki in Greece from 2005 to 2011. Since 2012 i have been then enrolled as a MSc student in the Pediatric Dentistry Department of Marmara University.

PERSONAL INFORMATION

Name	VASILIKI	Surname	TZIFA
Birth Place	IRAKLEIO	Birth Date	03/05/87
Citizen	GREEK	Identity Card Number	AB154323
E-mail	vasilikitzifa@gmail.com	Phone	05376470916

EDUCATION LEVEL

	The Institute Graduated From	Graduation Year
Doctorate		
Master		
Licence	Dental School, Aristotle University of Thessaloniki, Greece	2011
High school	Sitia High School	2005

Work Experience

	MISSION	INSTITUTE	DURATION (year - year)
1.	DENTAL PRACTICE	PRIVATE DENTAL PRACTICE	2011-2012

FOREIGN LANGUAGE	COMPREHENSION *	SPEAKING *	WRITING*
ENGLISH	EXCELLENT	EXCELLENT	EXCELLENT
TURKISH	Intermediate	Intermediate	Invalid
FRENCH	Intermediate	Well	Well

* Evaluate as Excellent , Well , Intermediate , Invalid

FOREIGN LANGUAGE COMPETENCY								
KPDS	ÜDS	IELTS	TOEFL IBT	TOEFL PBT	TOEFL CBT	FCE	CAE	CPE
			102/120			A		C

it is to be written all the successful examinations

KPDS: Kamu Personeli Yabancı Dil Sınavı; ÜDS: Interuniversity Board Foreign Language Examination ; IELTS: International English Language Testing System; TOEFL IBT: Test of English as a Foreign Language-Internet-Based Test TOEFL PBT: Test of English as a Foreign Language-Paper-Based Test; TOEFL CBT: Test of English as a Foreign Language-Computer-Based Test; FCE: First Certificate in

English; CAE: Certificate in Advanced English; CPE: Certificate of Proficiency in English

	Quantitative Reasoning	Equally Weighted	Verbal Reasoning
Academic staff and graduate education entrance examination (ALES)	155	69% below	155
OTHER SCORE			

COMPUTER KNOWLEDGE

PROGRAM	ABILITY TO USE
MICROSOFT OFFICE	EXCELLENT

*Evaluate as Excellent , Well , Intermediate, Invalid

International and national editions/proclamations/ certificate /prizes/ other

