Alma Mater Studiorum – Università di Bologna

DOTTORATO DI RICERCA IN
SCIENZE MEDICHE GENERALI e DEI SERVIZI

Ciclo XXVIII

Settore Concorsuale di afferenza: 06/F1

Settore Scientifico disciplinare: MED/28

TITOLO TESI

Full mouth ultrasonic debridement: a therapeutic protocol for periodontal disease treatment in patients with Down Syndrome

Presentata da: Martina Stefanini

Coordinatore Dottorato — Prof. Nicola Rizzo

Relatore — Prof.ssa GabrielaPiana

Esame Finale anno 2016

INDEX

1. INTRODUCTION

Down syndrome (DS) is the most common genetic condition, associated with intellectual disability, an increased risk of concomitant congenital defects, and organic disorders. Despite these risk factors, morbidity estimates of DS life expectancy suggest an increase in near future[1].

DS was recognized as a genetic condition only in the 19th century. Escorel described the appearance of a child with DS in 1838. Later in 1866 John Langdon Down published "Observations on an Ethnic Classification of Idiots", and used the name mongolism because of the facial resemblances to East Asian people[2-5]. Lejeune, Turpin and Gautier found the third chromosome 21 in patients with DS in 1959.

Starting from the identification of the extra chromosome 21 are initiated in vitro and clinical studies in order to understand the correlation with phenotypic traits characteristic of the syndrome and to understand the role of this chromosome

To understand DS, it is crucial both to understand the genomic content of chromosome 21 and how the expression levels of these genes are altered by the presence of this third copy.

Only recently,new observations have led to the identification of the long arm of chromosome 21 as the responsible region for the DS phenotype, the DS critical region (DSCR) . Chromosome 21 is the smallest chromosome, which may explain the presumed durability of this syndrome over the evolution [2]. At this moment more than 450 genes have been identified on chromosome 21, and genes have been identified specifically related to the DSCR [2,3,5]. [6]

REFERENCES

1. Coppus A, Evenhuis H, Verberne GJ, Visser F, van Gool P, Eikelenboom P, van Duijin C. Dementia and mortality in persons with Down's syndrome. J Intellect Disabil Res 2006;50:768-77.

2. Einfeld SL, Brown R. Down syndrome--new prospects for an ancient disorder. JAMA. 2010;303(24): 2525-6.

3. Roizen NJ. Down syndrome: Progress in research. Ment Retard Dev Disabil Res Rev 2001;7:38-44.

4. Crissman BG, Worley G, Roizen N, Kishnani PS. Current perspectives on Down syndrome: Selected medical and social issues. Am J Med Genet Part C Semin Med Genet 2006;142C:127-30.

5. Wiseman FK, Alford KA, Tybulewicz VL, et al. Down syndrome-recent progress and future prospects. Hum Mol Genet 2009;18:Review Issue 1:75-83.

6. Michel Weijerman Consequences of Down syndrome for patient and family ACADEMISCH PROEFSCHRIFT 2011 pag 8

2. PATIENT WITH DOWN SYNDROME

Down syndrome (DS) is the most common chromosomal malformations in newborns. In Europe, DS represents 8% of all recorded cases of congenital abnormalities. Worldwide, the overall prevalence of DS is 10 per 10,000 live births, although in recent years this figure is increasing. To a large extent, the prevalence of DS depends on various socio-cultural variables.(6,21,23)

In fact, these variables are related to factors such as the legality or illegality of abortion in different countries, the average women age in early pregnancy which results to be very uneven in the different countries, as well as the level of accuracy of the pre-natal screening. So probably in the Western world the percentage of DS diagnosis has increased thanks to a more precise pre-natal screening test and also because the maternal age has risen , however the percentage of new born with Down syndrome is not increased because of the increased pregnancy interruption.

DS is characterized by several dysmorphic features and delayed psychomotor development. Children with DS also have an increased risk of concomitant organic diseases and birth defects such as congenital heart disease and gastrointestinal defects, celiac disease and hypothyroidism.

Life expectancy in patients with SD has increased considerably and patients can now reach 50-60 years of age. The main cause of death is linked to congenital heart problems and secondly for respiratory infections. Conversely, cause of death from cancer appears to be lower than non SD except for some forms of cancer as leukemia and testicular cancer. Thanks to improved surgical techniques has greatly decreased the rate of infant mortality of patients with SD. In the Netherlands, the rate of infant mortality in children with DS has fallen from 7.07% in 1992 to 4% in 2003 (this is in contrast to the infant mortality rate 0.48% of the target population in the Netherlands in 2003)(33) The DS of mortality decline is mainly due to early surgical treatment success of CHD and to improve the treatment of congenital anomalies of the gastrointestinal

tract. Respiratory infections and neonatal problems are the most serious and frequent problems that can affect infants with DS.

Pre Natal screening and newborn assessment

There are several types of prenatal screening for the diagnosis of SD with different degree of accuracies and invasivenessThe ultrasound between 14 and 24 weeks of gestation is the least invasive method. It may be associated with blood sampling (combined test).Then there are the chorionic villus sampling at 11-12 weeks or amniocentesis around 15 weeks.Diagnosis at birth is based on clinical observation of the characteristics typical of the syndrome and on genetic examination in order to have the definitive diagnosis . Thanks to prenatal diagnostic techniques often parents are already aware at the time of birth that the child will be affected by SD. If instead by mistake or by choice, parents are not aware of his son's illness they should be promptly informed by pediatricians and briefed of possible congenital diseases related to the syndrome. 19,26

Phisycal characteristics

Individuals with DS may have some or all of the following physical characteristics: microgenia (abnormally small chin), oblique eye fissures, muscle hypotonia , flat nasal bridge, a single palmar crease, macroglossia, , short neck, white spots on eye and iris, known as Brushfield spots excessive joint laxity, excessive space between the big toe and second toe, and short fingers

The neck is short and squat, chest is plate and elongated, the abdomen is expanded and pelvis is lower and wide.

Congenital diseases associated with DS

DS is often associated with different congenital diseases:

cardiovascular disorders,vision disorders, ear, nose and throat disorders, respiratory disorders, gastrointestinal tract disorders, haemato-oncological and immunological disorders,endocrine disorders, orthopedics disorders , urinary disorders, dermatologic problems, sexual development and neuro-behavioral disorders.

Cardiovascular disorders

The prevalence of CVD in neonates with DS is about 44–58% worldwide. Atrioventricular septal defect (ADS) and ventricular septal defect (VSD) are the most common forms of CHD, constituting up to 54% for ASD and to 33% for VSD, of all CVDs in children with DS.[31,33]

Other most frequently cardiovascular anomalies consist of: left or right shunt, ostium primum persistence, patency of the interventricular septum, mitral valve disease and tricuspid , interventricular communication, persistence of Botallo duct, isolated septal communication, tetralogy of Fallot. Most of these heart conditions are corrected surgically in early childhood, with a very favorable prognosis.

The diagnosis of cardiovascular problems may occurs during prenatal screening tests and must be confirmed by early neonatal examinations. The early diagnosis allows to carry out a therapy in a short time. The diagnosis is made by means of echocardiography.

Vision disorders

Ocular alterations in Down Syndrome, play a central role in the clinical situation. The most

obvious abnormality is the appearance of the eyelid usually oblique and narrow laterally, sometimes associated with blefarocalasi, hypertelorism, eyelid ptosis and blepharophimosis. These aspects are associated, in most cases, to a vertical fold of skin between the inner corner of the eyelid and the back of the nose: the epicanthus.

The spotted iris is characteristic of Down Syndrome with a prevlence range between 38 to85%. The so-called Brushfield spots are slightly raised white areas on the surface steelhead usually collected in a concentric ring of the pupil to the union of the middle third to the outer third of the iris surface.This would be explained histologically by the fact that the area between the spots shows a number of stromal fibers below the average.These stains are present at birth and could be considered a useful diagnostic sign. Other vision disorders include strabismus (20–47%), nystagmus (11– 29%), congenital cataract (4–7%), acquired cataract (3–15%), blepharitis (7–41%), refractive errors (43–70%) and glaucoma (0.7%). Keratoconus is rare in childhood but develops later in life in individuals with DS.[27,36] An early visual screening is essential for prevention and detection of defects that can be treated.

Ear, nose and throat disorders

Hearing didorders and otologic problems are common in children with DS, and these problems are related to developmental problems. Midface hypoplasia is typical in children with DS and consists of abnormalities of the nasopharynx, abnormal Eustachian tube anatomy, abnormal tooth development and agenesis of the teeth. These mid-face problems are often associated with hypotonia and macroglossia and are responsible for chronic middle ear disease and chronic rhinorrhoea.

A variety of immune disorders makes DS patient prone to upper airway infections.[4] Even mild hearing loss can affect intellectual growth and cognitive development, and in consequence, it can affect child's articulation skills. Regular assessment of the hearing function is highly recommended. An early detection of chronic ear disease in children with DS, immediately after

birth, may improve hearing.[15] Moreover , in addiction to hearing problems, children with DS show delayed speech abilities.[21] Sleep-disordered breathing in children with Down syndrome is seen in half of the children with DS. The most common causes include macroglossia, glossoptosis, recurrent enlargement of the adenoid tonsils and enlarged lingual tonsils.

Respiratory disorders

Respiratory problems are responsible for the majority of the morbidity and hospital admissions in children with DS. Respiratory syncytial virus (RSV) is seen more frequently and is associated with a greater risk for hospitalization in children with DS.[4,13] Recurrent wheeze is very common among children with DS (it is found in up to 36%) and is related to previous RSV infection and to other factors such as tracheamalacia.[3,4] The clinical picture may mimic asthma but is not equivalent to asthma. These respiratory problems can in turn become exacerbated because of the existence of CVD with haemodynamic instability and as a result of hypotonia, both known characteristics of DS. Other causal factors include airway anomalies like tracheolaryngomalacia, pulmonary anatomical changes like pulmonary hypoplasia, and subpleural cysts. Subpleural cysts are common in individuals with DS (up to 36%).[2] Furthermore, an association with abnormal lung growth and lung hypoplasia is found in children with DS.[1 40]

Gastrointestinal tract disorders

Congenital birth defects of the gastrointestinal tract are present in 4-10% of children with DS and play an important role in morbidity during the first year of life. These defects are esophageal atresia / trachea-esophageal fistula (0.3-0.8%), pyloric stenosis (0.3%), the duodenal stenosis / atresia (1-5%), Hirschsprung's disease (1-3 %) and anal stenosis / atresia (<1-4%). These defects are more common in the population DS, as 25-30% of all cases of duodenal defects are in

children with the disease DS.[9] The majority of these abnormalities requires immediate surgery for the correction of anatomical damage. Particular attention should be given to the issue of meconium (within the first 24 hours of birth) and signs of bowel obstruction.These abnormalities of the gastrointestinal tract make difficult the feeding in the first years of life of children who are exposed to greater risk of suffocation due to obstruction of the upper airways.

Celiac disease (CD) is another DS-specific disorder and is seen in 5-7% of children with DS, a rate that is ten times higher than normal population screening.[38] Is definitely recommended early diagnosis of CD in DS population, in order to start the treatment and prevention of CD complications as failure to thrive, anemia, osteoporosis and malignant tumors. The occurrence of prenatal an aberrant right subclavian artery (ARSA, lusoria artery) has substantially increased in patients with DS, where it is at a maximum of 19-36%. ARSA can cause problems with the passage of solid food through the esophagus and dysphagia. In addition, impaired oral motor function, gastro-oesophageal reflux disease or congenital diseases should be considered as a cause of feeding problems in children with DS. [9,22]

Constipation is another important problem in children with DS and is basically related to hypotonia; essential to monitor the amount of calcium and vitamin D introduced with the diet, since, these patients have a reduced degree of bone density

Another very important issue with respect to nutritional aspects is represented by body weight control. Individuals with DS, in fact, have a reduced metabolic activity and this leads frequently to obesity. [21]

Haemato-oncological and immunological disorders

Trisomy 21 is also associated with many changes in cellular function at the level of the hematopoietic immune system. Although the incidence of infection has been considerably reduced thanks to the introduction of vaccinations for various viral and bacterial pathogens,to the widespread use of antibiotics and to the improved hygiene conditions, the immune system in SD patient is otherwise altered from both qualitative and quantity point of view. For this reason DS patient are exposed to a higher risk of infection during the entire life . Some authors reported abnormal maturation of thymus function and impairment of T cells on the contrary other authors showed that, although many immune cells are immature, the B lymphocyte count is normal or only slightly reduced.In Downs patients an altered turnover of polymorphonuclear (PMN) is frequently observed. Circulating PMN and monocytes showed functional defects (i.e. reduced chemotaxis). More surprising, though quantitatively much less important, is the propensity of children with Down syndrome to develop acute leukemia, the most commonly acute megakaryoblastic (M7) leukemia, with a frequency twenty times higher than that in the normal population (39). This is often preceded by neonatal reaction leukemoid (transient myeloproliferative diseases), which could be a form of leukemia transient. Leukemia affects roughly one child every 200 Down, 10-15 times more compared to the frequency with which it occurs in the disease normal population (32).Conversely, the risk of development of malignant solid tumors is rather low compared to the rest of the population. However, in these cases, children with Down syndrome appear to have a better prognosis and require less chemotherapy than children without DS.

Endocrine disorders

Thyroid disorders have been reported in up to 28–40% of children with DS, and this percentages increase with age up to 54%.[10,15,28] Thyroid abnormalities in DS population included congenital hypothyroidism (1.8–3.6%) , primary hypothyroidism, autoimmune (Hashimoto) thyreoiditis (0.3–1.4%),compensated hypothyroidism (25.3–32.9%) and hyperthyroidism (Graves' disease) (0–2%). The most common causes of hypothyroidism are acquired autoimmune: the body starts producing antibodies against the thyroid. In some cases, despite the presence of autoantibodies, thyroid succeeds in produce a sufficient amount of thyroxine (T4) and the therapy is not necessary and frequent checks are required only. In others, however, it is necessary replacement therapy, is very simple and very effective. Very often detection (with a simple blood test) of anti-thyroid antibodies (anti-thyroglobulin, anti-peroxidase, anti-microsomal) even years before clinical manifestations of autoimmune thyroiditis.The clinical manifestations are:growth retardation, reduction of muscle tone, constipation and dry skin which can easily be underestimated because confused with characteristics of the syndrome.Due to this endocrine disorders Children with DS have their own particular growth pattern and DS-specific growth curves.[7] The follow-up of length and weight in children with DS should be part of the regular medical screening with care in order to avoid overweight. In fact because of the metabolic problem, their propensity to over-eating and the lack of exercise parents have to constantly monitor the weight.[21]

Orthopedic disorders

The motoric system of children with DS is characterized by ligamentous laxity, joint hypermobility and hypotonia presenting in a variety of ways.[5,15] Craniocervical instability has been reported in 8% to 63% of children with DS; atlanto-axial instability (AAI) occurs in 10% to 30%. The delayed recognition of this condition can cause irreversible damage of the spinal cord. The instability can occur at the atlanto-axial or occipital-cervical joint. The atlanto-axial laxity

can be associated with the presence of an abnormal amount of collagen in the ligament level sideways, which, in turn, can cause an abnormal motion between the segments that lead to instability. Standardized radiographs of the cervical spine, including the 'front to back, mouth open, are useful tools to identify this instability, which is diagnosed on the basis of the increase of the atlanto-dental interval, (ADI), of the cervical spine. The occipital-cervical instability is on the other hand more difficult to diagnose with radiographic techniques due to the overlap of the bony structures at the base of the skull.

Although scoliosis can occur in association with Down syndrome. Most cases of scoliosis in these patients is presumed to be of toracogenica nature, since it occurs secondarily to a thoracotomy pre-cardiac surgery. Acquired hip dislocation occurs in about 30% of children with DS and requires special attention. Very common is the presence of the flat-valgus foot and pronounced pronation of the foot, causing a difficult walking.

Urinary tract disorders

Children with DS have significantly more risk of urinary tract anomalies (UTAs) (3.2%) such as hydronephrosis, hydroureter, renal agenesis and hypospadias. The diagnosis is performed by means of ultrasound. Symptoms are not always easy to detect and may be masked because voiding disturbances and delayed toilet training are usually interpreted as a consequence of delayed psychomotor development. [16 40]

Dermatologic problems

Dermatologic diseases are often present and are especially troublesome in adolescents[21] and included: vitiligo (1.9%), seborrhoeic eczema (8–36%), folliculitis (10.3–26%) and syringoma (12.3–39.2%) are more frequently seen in children with DS. Rare but DS-specific problems are elastosis perforans serpiginosa and milia-like idiopathic calcinosis cutis.[18,23] A previously reported high prevalence of atopic dermatitis (AD) in up to 56.5% of children with DS is probably an overestimation, as more recent studies suggest a lower prevalence of 1.4–3%. This could be the result of new and different diagnostic criteria for AD. This observation also notes a lower allergy risk in children with DS, which is in concordance with the studies on allergic rhinitis.[17,18,23]

Another very frequent cutaneous manifestation in patients with DS is alopecia, a condition characterized by irregular hair loss presumably due to an impaired immune response the hair follicles. This "disease" occurs in patients with DS with a frequency ranging from 5% to 9%, against a percentage that in normal population ranges between l% and 2%. The hair loss may being either permanent or temporary and can occur simultaneously on more areas of the scalp.

Neuro-behavioral disorders

In DS patients the IQ values vary, usually ranging from 35 to 70, indicating mild to moderate mental impairment; severe mental impairment is only occasionally seen in children with DS.[8] Counterproductive behaviour and avoidance tactics can impede learning, and language production is often substantially impaired. .[15,21] Furthermore, impaired oral motor function can influence articulation. The SNC suffers the effects of the trisomic state for life. Except of a

certain degree of hypoplasia of the cerebellum , the brains of subjects suffering from SD is grossly normal. Except central hypotonia, which is perhaps the most frequent sign of SD, individual development is characterized by delay in cognitive development in early childhood, which is translates, in childhood, in a mild or moderate mental retardation, followed by the loss of cognitive skills in adulthood and the development of Alzheimer's disease (AD) in the following years. In fact, the deposition of the amyloid protein it has been observed in the second decade of life in the affected subjects. The manifestation of the complete pathology AD seems to be getting this for ages 35 years and older - a fifty years earlier than the normal population.[21]

Children with DS have more pronounced neurobehavioral and psychiatric problems, found in 18% to 38%. The most frequent problems are disruptive behavior disorders, such as attention deficit hyperactivity disorder (6.1%), conduct/oppositional disorder (5.4%) or aggressive behavior (6.5%), and obsessive–compulsive disorders. More than 25% of adults with DS have a psychiatric disorder, most frequently a major depressive disorder (6.1%) or aggressive behavior (6.1%).[15,21 40]A diagnosis of autism or autism spectrum disorders in children with DS is found in 7%. This diagnosis is not easily made in children with DS mainly because of the resemblance and overlap of DS-specific behaviors and autism.

Epilepsy is seen in 8% of children with DS, with 40% occurring in infancy and often presenting as infantile spasms.[40]

Education and school

Early intervention education systems are programs that can be used from the first months of life and provide tools to stimulate the development of children with DS, especially in the preschool period. Children with DS often begin primary school with extra support; successful outcomes are mainly in the area of social skills as a result of the ability to copy and mirror behavior. The outcome for adult social independence depends largely on the development of abilities to complete tasks without assistance, the willingness to separate emotionally from parents and access to personal recreational activities.[21 40]

CONCLUSION AND RECOMMENDATIONS

The Down syndrome is a complex pathology and associated with a number of systemic diseases with different level of severity. Mental retardation is always present, but often mild. Patients with DS should be monitored from birth for systemic diseases and to enhance and improve as much as possible the development and cognitive abilities. Life expectancy has increased considerably compared to the past and thus the effects of this age-old disease must be studied. Support for families is fundamental in helping patients with DS. [40]

REFERENCES

1. Bertrand P, Navarro H, Caussade S, et al. Airway anomalies in children with Down syndrome: endoscopic findings. Ped Pulm 2003;36:137-41.

2. Biko DM, Schwartz M, Anupindi SA, Altes TA. Subpleural lung cysts in Down syndrome: prevalence and association with coexisting diagnoses. Pediatr Radiol 2008;38:280-4.

3. Bloemers BLP, van Furth AM, Weijerman ME, et al. Down syndrome: a novel risk factor for respiratory syncytial virus bronchiolitis—a prospective birth-cohort study. Pediatrics 2007;120:e1076-e81.

4. Bloemers BLP, van Furth AM, Weijerman ME, et al. High incidence of recurrent wheeze in children with Down syndrome with and without previous respiratory syncytial virus lower respiratory tract infection. Pediatr Infect Dis J 2010;29:39-42.

5. Caird MS, Wills BP, Dormans JP. Down syndrome in children: the role of the orthopaedic surgeon. J Am Acad Orthop Surg 2006;14:610-9.

6. Collins VR, Muggli EE, Riley M, et al. Is Down syndrome a disappearing birth defect? J Pediatr 2008;152:20-4.

7. Cremers MJ, van der Twee I, Boersma B, et al. Growth curves of Dutch children with Down syndrome. J Intellect Disabil Res 1996;40:412-20.

8. Cunnif C, Frias JL, Kaye C, et al. Health supervision for children with Down syndrome,

American Academy of Pediatrics. Pediatrics 2001;107:442-9.

9. Freeman SB, Torfs CA, Romitti MH, et al. Congenital gastrointestinal defects in Down syndrome: a report from the Atlanta and National Down Syndrome Projects. Clin Genet 2009;75:180-4.

10. Gibson PA, Newton RW, Selby K, et al. Longitudinal study of thyroid function in Down's syndrome in the first two decades. Arch Dis Child 2005;9:575-8.

11. Guidelines for basic essential medical surveillance. The Down's syndrome medical interest group UK and Ireland. Available at: http://www.dsmig.org.uk/publications/guidelines.html. Accessed 29 Jan 2010.

12. Hankinson TC, Anderson RC. Craniovertebral junction abnormalities in Down syndrome. Neurosurgery 2010;66:A32-8.

13. Hilton JM, Fitzgerald DA, Cooper DM. Respiratory morbidity of hospitalized children with Trisomy 21. Paediatr Child Health 1999;35:383-6.

14. Irving C, Basu A, Richmond S, et al. Twenty-year trends in prevalence and survival of Down syndrome. Eur J Hum Genet 2008;16:1336-40.

15. Kishnani PS, Crissman BG. Special issue: current perspectives on Down syndrome: selected medical and social issues. Am J Med Genet C Semin Med Genet 2006;142C:127-205.

16.Kupferman JC, Druschel CM, Kupchik GS. Increased prevalence of renal urinary tract anomalies in children with Down syndrome. Pediatrics 2009;124:e615-21.

17.Mannan SE, Ejaz Y, Hossain J. Prevalence of positive skin prick test results in children with Down syndrome: a case control study. Ann Allergy Asthma Immunol 2009;102:2005-9.

18.Madan V, Williams J, Lear JT. Dermatological manifestations of Down's syndrome. Clin Exp Dermatol 2006;31:623-9.

19.Muggli EE, Collins VR, Marraffa C. Going down a different road: first support and information needs of families with a baby with Down syndrome. MJA 2009;190:58-61.

20.Rex AP, Preus M. A diagnostic index for Down syndrome. J Pediatr 1982;6:903-6.

21.Roizen NJ, Patterson D. Down's syndrome. Lancet 2003;361:1281-9.

22.Roofthooft MT, van Meer H, Rietman WG, et al. Down syndrome and aberrant right subclavian artery. Eur J Pediatr 2008;167:1033-6.

23.Schepis C, Barone C, Siragusa M, et al. An updated survey on skin conditions in Down syndrome. Dermatology 2002;20:234-8.

24.Shin M, Besser LM, Kucik JE, et al. Prevalence of Down Syndrome among children and adolescents in 10 regions of the United States. Pediatrics 2009;124:1565-71.

25.Shott SR, Amin R, Chini B, et al. Obstructive sleep apnea should all children with Down syndrome be tested? Arch Otolaryngol Head Neck Surg 2006;132:432-6.

26.Skotko BG, Capone GT, Kishnani S. Postnatal diagnosis of Down syndrome: synthesis of the evidence on how best to deliver the news. Pediatrics 2009;124:e751-8.

27.Stephen E, Dickson J, Kindley AD, et al. Surveillance of vision and ocular disorders in children with Down syndrome. Dev Med Child Neurol 2007;49:513-5.

28.Unachak K, Tanpaiboon P, Yupada Pongprot Y, et al. Thyroid functions in children with Down's syndrome. J Med Assoc Thai 2008;91:56-61.

29.van Trotsenburg ASP, Vulsma T, van Rozenburg-Marres SLR, et al. The Effect of thyroxine treatment started in the neonatal period on developmentand growth of two-year-old Down syndrome children: a randomized clinical trial. J Clin Endocrinol Metab 2005;90:3304-11.

30.van Wouwe JP, Siderius EJ, Borstlap R, et al. Optimal medical care for children with Down syndrome and their parents. Ned Tijdschr Geneeskd 2001;145:1617-21.

31.Vis JC, Duffels MGJ, Winter MM, et al. Down syndrome: a cardiovascular perspective. J Intellect Disabil Res 2009;53:419-25.

32.Volman MJ, Visser JJ, Lensvelt-Mulders GJ. Functional status in 5 to 7-year-old children with Down syndrome in relation to motor ability and performance mental ability. Disabil Rehabil 2007;29:25-31.

33. Weijerman ME, van Furth AM, Vonk Noordegraaf A, et al. Prevalence, neonatal characteristics and first-year mortality of Down syndrome: a national study. J Pediatrics 2008;152:15-9.

34. Weijerman ME, van Furth AM, Mooren MD, et al. Prevalence of congenital heart defects and persistent pulmonary hypertension of the neonate with Down syndrome. Eur J Pediatr 2010. doi:10.1007/s00431-010-1200-0.

35. Wiseman FK, Alford KA, Tybulewicz VL, et al. Down syndrome—recent progress and future prospects. Hum Mol Genet 2009;18(R1):75-83.

36. Wong V, Ho D. Ocular abnormalities in Down syndrome: an analysis of 140 Chinese children. Pediatr Neurol 1997;16:311-4.

37. Wouters J, Weijerman ME, van Furth AM, et al. Prospective HLA, EMA, and TGA testing celiac disease in children with Down syndrome. J Pediatrics 2009;154:239-42.

38. Yang Q, Rasmussen SA, Friedma JM. Mortality associated with Down's syndrome in the USA from 1983 to 1997: a population-based study. Lancet 2002;359:1019-25.

39. Zwaan MC, Reinhardt DR, Hizler J, Vyas P. Acute leukemias in children with Down syndrome. Pediatr Clin North Am 2008;55:53-70.

40. Michel Weijerman Consequences of Down syndrome for patient and family ACADEMISCH PROEFSCHRIFT 2011

3. ORAL CAVITY ANOMALIES IN PATIENT WITH DOWN SYNDROME

Palate. The development of the mid face is less complete than that of the mandible. This incomplete development (midface complexis) results in reduction of the length, height, and depth of the palate, whereas the width is not markedly affected[4,]. Significant reduction in length gives the palate a "stair palate" appearance with high arch and occasionally palatal cleft-like folds are found. Also V-shaped high vault palates may show soft palate insufficiency[4] and reduce the retention of maxillary dentures. Patients should be evaluated for orthodontic and surgical correction.

Lips, oral opening, and covering mucosa. Hypotonia of the orbicularis muscle, the zygomatic arch, masseter and temporal muscles can result in several significant features. Characteristic facial appearance of SD is represented by the lower lip hypotonic with tongue protrusion.

The lips are always slightly open because of the excessive size of the tongue which then protrudes from the outside of the oral cavity. This, associated with a typical xerostomia cause annoying angular cheilitis and dryness of mucous membranes.[4,1]

Tongue: patients with DS show numerous abnormalities of the tongue.

The tongeu is often hypotonic and protrudes. Macroglossia is not always true, but it is often apparent.

The problem seems to be in fact linked to a reduced size of the oral cavity instead of a real excessive size of the tongue.

The tongue due to an excessive pressure to the lower incisor present the footprint of these elements on the tip. These problem called crenated tongue present a typical pattern shown as ovals depressed which are circumscribed by a white scalloped edge raised. This manifestation is always harmless and asymptomatic [5] .

Another feature is the presence of fissures of different lengths and depths on the dorsal surface of the front two-thirds of the tongue. In Down's syndrome can occur in combination with geographic tongue. These fissures can become impacted with food and cause halitosis. This can be controlled by regular brushing of the dorsal surface of the tongue. [5]

Denatal anomalies in DS patients included:

The *microdontia* affects 35-55% of SD. Dental elements are small than normal in both crown and root dimensions . Spitzer (1963) described them as "stunted with short, small crowns and roots." Kissling (1966) examined the diameters of the teeth and found that all the teeth, except for the first upper molars and lower incisors were reduced in size, but that the root formation was always root complete [6].

It can be assumed that the small size of the dental elements could be related to the small body size that DS patients show respect to the normal population.

Taurodontism: taurodontic teeth present with elongated pulp chambers and apical displacement in multi-rooted teeth . In DS it is common and the prevalence ranged from 0.54% to 5.6%. The most affected tooth is the second lower molar

Hypoplasia and / or hypocalcification are frequently observed. These abnormalities may be caused either by congenital malformations or by the use of tetracyclines in 'childhood for the treatment of infections. With this kind of dental anomalies we recommend a treatment that may include sealing or professional fluoride applications to prevent the worsening of the situation.

These anomalies of form, size and calcification can all relate to each other and may result in a decrease in mitotic activity of dental progenitor cells during embryogenesis. [11]

Partial anodontia. Congenitally missing teeth are more common among people with Down syndrome (50%) than the general population (2%), although the distribution of missing teeth is similar in both populations [6]. the mode of genetic transmission are responsible for this condition. A relationship between partial anodontia and other ectodermal defects (mucosa, hair, skin) was suggested [4]. Missing teeth more frequently in descending order are third molars, second premolars, lateral incisors and lower incisors. The only teeth never missing is the first molars [6]. Sometimes the primary tooth will not be absorbed or will be absorbed so slowly that it can be maintained in adulthood. [8]

Tooth agenesis. Agenesis is 10 times more common in patients with Down syndrome than in the general population; there is a greater frequency in males and females, in the lower jaw than in the upper jaw, and on the left side than on right. [12] The most affected tooth are the lower central incisors, followed by upper lateral incisors, second premolars, and second lower premolar. Canines and first molars are rarely affected. Agenesis of canines and second molars was seen both in the maxilla and the mandible, where as the first molar agenesis was seen only in mandible [12].

Dental caries. Low prevalence of dental caries in patients with Down syndrome is a favorable factor in the clinical management of these people. Orner's [13] study contrasts with dental caries experience of patients with Down syndrome with that of their sibilings; It found that patients with Down syndrome have experienced less than a third of caries than their unaffected siblings.

Shapira et al. [20] has found that adults with Down syndrome who were caries free had significantly lower Streptococcus mutans counts than patients with dental caries. Several factors are considered responsible for the low prevalence of caries. Delayed eruption, reducing the time of exposure to a cariogenic environment, congenital missing teeth, higher salivary pH and bicarbonate levels (which provide better buffering action), microdontia, spaced teeth, and surface cracks of teeth contribute to this lower risk of dental caries. [14]

Eruption of the primary dentition. Eruption of teeth is delayed in timing and sequencing, especially in the anterior maxillary and mandibular teeth and first molars. Central incisors erupt first and second molar usually last, but in the middle there is a large amount of variation in the sequence of eruption [8]. The first eruption is usually at the age of 12 to 14 months, but may be delayed up to 24 months [8]. By the time the primary dentition is completed the child may be from 4 to 5 years of age.

Eruption of the permanent dentition. As the primary dentition, first eruption in permanent dentition is delayed. Six-year molars and lower incisors can not erupt until the age of 8-9 years [15]. The chronological sequence of eruption in Down syndrome is rather similar to that of the general population. [15]

Occlusion anomalies

The following are oral manifestations related to occlusion and may require orthodontic or surgical intervention.

Malalignment. A study by Ondarza et al.[16] analyzed patients with Down syndrome and showed a higher frequency of malalignments in both the deciduous and permanent dentition compared with a group without Down syndrome. The most frequently involved teeth are central incisors, lateral incisors and canines.

Malocclusion. The following factors play an important role in malocclusion: mouth breathing (96%), improper chewing (60%), evidence of bruxism (45%), tooth agenesis (12.7%), midline deviation in maxillary arch (80%), an anterior open bite (45%), dysfunction of temporo-mandibular joint (24%), delayed eruption and exfoliation of both primary and secondary dentition, characteristic tongue thrust, hypotonic ligamentary apparatus of mandibular joint, developmental disturbances of the mandible (platybasia) and maxilla (mid-facial complex), and the jaw relationships.

Jaw relationships. Several findings were reported by Kissiling (1966) in Down syndrome patients[6]. They are as follows: (1) mandibular overjet (69%); (2) anterior open bite (54%); (3) posterior cross bite (97%); (4) anterior cross bite (second largest category); (5) mesial molar occlusion (protruding mandible) (65%); (6) sagittal malocclusion (a result of relatively short maxilla and short middle cranial fossa).

Midfacial complex. The midface in Down syndrome patients is more deficient than the mandible[3]. The anterior cross bites are attributed primarily to an anteroposterior deficiency of the maxillary arch rather than a constriction in the transverse dimension. This is further promoted by a lack of vertical development of the maxilla resulting in over closure of the mandible and

projecting the mandibular arch forward in relation to the maxilla. Because the mandible is not significantly affected, the apparent prognathism should be attributed primarily to the maxillary deficiency rather than to enlargement of the mandible[3].

Platybsia. Platybsia refers to the obtuse angle is formed by the anterior cranial base segment to the posterior cranial base segment to such a degree that it appears as a straight line, indicating a flat cranial base[18]. Failure of the occipital bone to grow down and back keeps the glenoid fossa high, which influences the position of the mandible to the glenoid fossa. Because there is a simultaneous maxillary deficiency, the mandible is not rotated[3]. Fisher- Brandies[18] concluded that mandibular size starts at normal values but becomes mildly hypoplastic at age 14 and the gonial angle develops normally. From a longitudinal radiographic investigation, Reuland-Bosma and Dibbets[19] found that the morphologic characteristics of the lower jaw are normal, but those of the symphysis are not.

Bruxism. Bruxism is a common manifestation that starts early in life and sometimes persists throughout a person's life[8]. Initially bruxism eliminates some of the secondary and tertiary grooves and fissures found in newly erupted teeth. Over time, however, bruxism can lead to overloading the supporting tissue and its subsequent breakdown. In young children, "transitory" brux- ism is not uncommon[8]. In the preschool age child, bruxism rarely requires any active treatment. For active treatment a "mouth guard" type appliance may be used. The nature of the appliance will depend on individual needs. The appliance may not break the habit but rather protects the teeth. It redirects the child and thereby dismpts this self-stimulation activity[8].

Obstructive sleep apnea : people with trisomy 21 for their facial characteristics and for their functional impairement such as:

-relatively low muscle tone

- narrow nasopharynx

- wide and hypotonic tongue

and for their tendency to obesity and to develop recurrent infections at the level tonsil, are more likely than the general population to present sleep apnea or obstructive airway disease .

The estimated incidence of central causes of sleep apnea in DS patient is very high

(89% of cases), while the Obstructive Sleep Apnea (OSA) has a variable frequency from 30 to 60%. OSAS is a disease characterized by repeated episodes of complete or partial obstruction of the upper airway during sleep, usually associated with a reduction of the saturation of oxygen in the blood . Surgery, tonsillectomy and adenoidectomy, it is often the first choice of treatment, but in 30-50% subjects the problem persists despite intervention.

REFERENCES

1. Wilson MD. Special considerations for patients with Down syn- drome. ODA J 1994;184:24--5.
2. Fisher WL Jr. Quantitative and qualitative characteristics of the face in Down syndrome. J Mich Dental Assoc 1983;65:105-7.
3. Sassouni V, Forrest E. Dentofacial pathology related to maloc- clusion. Orthodontics in Dental Practice. St. Louis: CV Mosby; 1971. p. 169-97.
4. Limbrock G, Fischer-Brandies H, Avalle C. Castillo-Morales' orofacial therapy: treatment of 67 children with Down syn- drome. Dev Med Child Neurol 1991;33:296-303.
5. Langlais RE Miller CS. Conditions peculiar to the tongue. Color Atlas of Common Oral Diseases. Malvern, PA: Lea & Febiger; 1992. p. 42-4.
6. Stark A. Dentistry: Down syndrome advances in biomedicine and behavioral sciences. In: Rynders JE. editor. Cambridge, MA: 1982. p. 198-203.
7. Garn SM, Cohen M, Gall JC, Nagy J. Relative magnitudes of crown size reduction and body size. J Dent Res 1971;50:513.
8. Sterling ES. Oral and dental considerations in Down syndrome. In: Lott I, McCoy E, editors. Down syndrome advances in med- ical care. New York: Wiley-Liss; 1992. p. 135-45.
9. Jaspers M. Taurodontism in the Down syndrome. Oral Surg Oral Med Oral Pathol 1981;51:632-6.
10. Ibsen O, Phelan J. Developmental disorders. Oral pathology for dental hygienist. Philadelphia: WB Saunters Co; 1996. p. 246- 7.
11. Townsend GC. Dental crown variants in children and young adults with Down syndrome. Acta Odontol Pediat Doc 1986;7:35-9.

12. Russell BG, Kjaer I. Tooth agenesis in Down syndrome. Am J Med Genet 1995;55:466-71.

13. Orner G. Dental caries experience among children with Down syndrome and their sibs. Arch Oral Bio 1975;20:627-34.

14. Chan AR. Dental caries and periodontal disease in Down's syndrome patients. Univ Toronto Dent J 1994;7:18-20.

15. Ondarza A JL, Blanco R, Valenzuela C. The sequence of eruption of permanent dentition in a Chilean sample with Down syndrome. Arch Biol 1993;38:85-9.

16. Ondarza A JL, Bertonati MI, Blanco R. Tooth malalignments in Chilean children with Down syndrome. Cleft Palate Craniofac J 1995;32:188-93.

17. Borea G, Magi M, Mingarelli R, Zamboni C. The oral cavity in Down syndrome. J Pedodontics 1990;14:139-40.

18. Fischer-Brandies H. Cephalometric comparison between children with and without Down syndrome. Eur J Orthod 1988; 10:255-63,

19. Reuland-Bosma W, Dibbets JM. Mandibular and dental development subsequent to thyroid therapy in a boy with Down syndrome. ASDC J Dent Child 1991;58:64-8.

20. Shapira J, Stabholz A, Schnrr D, Sela MN, Mann J. Caries lev- els, Streptococcus mutant counts, salivary pH and periodontal treatment needs of adult Down syndrome patients. Special Care Dentistry 1991;11:248-51.

4. PERIODONTITIS IN DOWN SYNDROME PATIENTS

The incidence of T21 is one in 800 to 1,000 live births in the United States. Generally, these patients now live to age 50 and some to age 60. As life expectancy increases, medical and social costs garner greater attention. Also, societal changes have allowed for better quality of life. Dental practitioners are challenged by the high incidence of early onset aggressive periodontal disease in T21; these patients have higher levels of periodontal pathogens and periodontitis-associated interproximal bone loss. The complex anatomy, physiology, immunology, and microbiology underscore the need for further investigation in specific areas related to dental treatment of these patients.

International literature[11,12,13] showed how patients with Down syndrome (DS) are affected by a high incidence of gingivitis and periodontal disease, compared to the general population. The high prevalence and severe destruction are because of altered genetic factors that predispose to disease and poor skills to perform hygiene procedures[11,12,13]. For individuals with DS who lived in institutions, a periodontal prevalence of 90% was observed in individuals aged between 1 and 39, whereas 36% of DS children with less then 6 years of age had periodontal pocket formation[1]. Orner[2] observed that the periodontal disease in DS population occurred early and is characterized by a highly aggressive and severe destruction of the periodontal attachment with higher prevalence (89%) compared to their age-matched and chromosomally normal siblings (58%). Periodontal disease is considered to be a multifactor disease in which both endogenous factors, such as genetics and host immune response, and exogenous factors, such as oral hygiene contribute to the occurrence of the disease[3]. In patients with DS, oral home hygiene can be affected by poor compliance due to hands incoordination, insufficient motivation and difficulty

on the part of the caregiver in performing effective oral hygiene with classical devices[4]. However, the higher prevalence and severity of periodontal disease, which cannot be explained by poor oral hygiene alone is related to changes in the immune response. Swallow[5] found that in DS patients the prevalence of periodontitis was higher in comparison to mentally retarded patients in three different environments: institutions, day training centers, and special schools. Although there were no differences in socioeconomic status, personal/professional dental care, or mental disability,[6] the clinical attachment loss was found to be greater in DS patients than in mental retarded patients and control individuals ($p<0.001$). According to these findings several studies have suggested that abnormalities in the immune response of DS patients are important contributing factors to the high incidence of periodontal disease. Reduced expression of IL-10 coupled with a possible increase of STAT3 activation indicates an important modulation of the immune response, with attenuation of anti-inflammatory and increase of pro-inflammatory mediators[7].

Subjects with DS and gingivitis exhibit higher concentrations of MMPs in gingival crevicular fluid and an altered relationship between MMP-8 and TIMP-2, which might impair the periodontal tissue turnover[8].

Oxidative burst activity of peripheral monocytes and granulocytes is elevated in DS affected individuals and may contribute to periodontal tissue inflammation and loss of periodontal attachment in this susceptible group[9].

The use of simple techniques and chemical antibacterial agents could be an important aid to mechanical procedure, in order to prevent the occurrence of periodontal disease[10].

Periodontal treatment in Down syndrome patients.

While healthcare professionals may be familiar with the social and medical management of Down syndrome, dental issues have traditionally been somewhat neglected and are important causes of morbidity.

Periodontal disease has been found to be significantly more prevalent and more severe in people with Down syndrome. A series of studies have reported a prevalence of between 58% and 96% for persons younger than 35 years of age. This phenomenon cannot simply be attributed to poor oral hygiene. The etiology of periodontal disease in persons with Down syndrome is complex. In recent years, much focus has been placed on the altered immune response resulting from the underlying genetic disorder. [17]

Increased loss of periodontal attachment in patients with Down Syndrome was not associated with differences in socioeconomic status, personal or professional dental care, or mental retardation. These data are consistent with the conclusion that the pathogenesis of periodontitis in patients with Down Syndrome is not governed by the known risk factors of periodontitis in the general population[19].

Underlying immunologic deficiencies associated with Down syndrome, including decreased neutrophil chemotaxis, contribute to a diminished host response that accounts for the severity and progression of periodontitis[21].These individuals may already have physiological limitations for efficient swallowing and mastication.Painful and inflamed oral tissues associated with periodontitis can exacerbate this, making it difficult to achieve appropriate caloric intake and perform oral hygiene practices, ultimately diminishing quality of life[20].Subjects with Down syndrome experience a high prevalence of periodontal disease, and the management of this disease in subjects with Down Syndrome is a challenge for oral health care providers.

Ronald et al. [15] followed the periodontal healing response changes over a 12-month period after non-surgical mechanical periodontal therapy with the adjunctive use of chlorhexidine and

monthly recalls in adults with DS who presented initially with chronic periodontitis. Following their protocol, satisfactory healing responses were achieved in adults with DS with chronic periodontitis and mild-to-moderate learning, decreasing the number of sites with bleeding on probing decreased from 82.1% to 29.5% and the mean probing depth from 3.2 to 1.8 mm, with a mean clinical attachment level gain of 0.6 mm[15].

In a pilot study Tanaka et al. [14] found that, although the mechanical periodontal treatment seemed to be effective in DS subjects over a short-term period, the red complex bacteria levels did not decrease significantly in dis- eased sites, as occurred in controls. Therefore, for DS patients, it seems that the conventional non-surgical periodontal therapy should be improved by utilizing adjuvants to reduce the presence of periodontopathogens.

Zaldivar-Chiapa et Al. [16] evaluated the effectiveness of surgical and non-surgical periodontal therapies and analyzed immunological status in a population of young Down syndrome patients (14-30 years). Surgical and non-surgical periodontal therapies were compared in a split-mouth design. Both therapies showed a significant improvement in all the clinical parameters compared to baseline. There was a significant PD reduction with the non-surgical therapy at 1 to 3 mm PD, in PD >3 mm the surgical therapy showed better results. Neutrophil chemotaxis, phagocytic activity, and production of super-oxide anion were significantly decreased in the DS patients. There is partial impairment of immunological functions in DS individuals which does not seem to affect the clinical response to therapy[16].

Cheng RH et Al. [23] followed the periodontal healing response changes over a 12-month period after non-surgical mechanical periodontal therapy with the adjunctive use of chlorhexidine and monthly recalls in adults with DS who presented initially with chronic periodontitis. Twenty-one subjects with DS (14 males and seven females; 25.3 +/- 5.5 years of age) with reported mild-to-moderate learning disabilities and chronic periodontitis were recruited and treated by non-surgical mechanical periodontal therapy (followed by monthly recalls) and the adjunctive use of chlorhexidine gel for toothbrushing and chlorhexidine mouthwash twice daily. After 12 months of non-surgical mechanical periodontal therapy, the mean percentage of sites with plaque decreased from 84.1% to 23.6%, bleeding on probing decreased from 82.1% to 29.5%, mean

probing depth decreased from 3.2 to 1.8 mm. Such a treatment regimen seems appropriate and beneficial for adults with Down Syndrome and chronic periodontitis.

Yoshihara T et al. [18] examine the effect of periodic preventive care on the progression of periodontal disease in 24 young adults with Down's syndrome dividing into two groups: 13 subjects who had frequently had professional tooth cleaning, various combinations of scaling, and counseling for caregivers regarding caries and periodontal disease and 11 subjects who had not visited our clinic for more than 1 year. The progression of periodontal disease in the subjects was evaluated clinically, microbiologically and roentgenologically. The results of this study show that individualized preventive dental care, performed regularly using generally available methods and maintaining adequate oral hygiene, are effective for suppressing the severity and progression of periodontal diseases in DS patients.

Treatment recommendations range from conservative to aggressive regimens, depending on the severity of the presentation. It is known that some periodontal pathogens may not be eliminated solely by mechanical debridement; therefore, antibiotics and chemical therapeutics often serve an important role in achieving successful outcomes[22].

Therapeutic protocols should include behavioral and social aspects for pediatric Down Syndrome patients. This would assist providers in making timely management decisions and facilitate diagnosis and management of periodontal diseases in this cohort. Though the approach to care should be carefully individualized.

REFERENCES

1. Brown RH, Cunningham WM. Some dental manifestations of mongolism. Oral Surg Oral Med Oral Pathol 1961;14:664-676.

2. Orner G. Periodontal disease among children with Down's syndrome and their siblings. J Dent Res 1976; 55:778-782.

3. Albandar JM. Global risk factors and risk indicators for periodontal diseases. Periodontol 2000 2002;29: 177-206.

4. Amano A, Kishima T, Akiyama S, Nakagawa I, Hamada S, Morisaki I. Relationship of periodontopathic bacteria with early-onset periodontitis in Down's syndrome. J Periodontol. 2001 Mar;72(3):368-73

5. Swallow JN. Dental disease in children with Down's syndrome. J Ment Defic Res 1964;8:102-118.

6. Khocht A, Janal M, Turner B. Periodontal health in Down syndrome: Contributions of mental disability, personal, and professional dental care. Spec Care Dentist 2010;30:118-123.

7. Cavalcante LB, Tanaka MH, Rico Pires J et al. Scarel-Caminaga Expression of the Interleukin-10 Signaling Pathway Genes in Individuals With Down Syndrome and Periodontitis J Periodontol 2012;83:926-935

8. Tsilingaridis G, Yucel-Lindberg T, Mode_er T. Altered relationship between MMP- 8 and TIMP-2 in gingival crevicular fluid in adolescents with Down's syndrome.J Periodont Res 2013; 48: 553–562

9. Khocht A, Russell B, Cannon JG, Turner B, Janal M. Oxidative burst intensity of peripheral phagocytic cells and periodontitis in Down syndrome. J Periodont Res 2014; 49: 29–35.

10. Husseini A1, Slot DE, Van der Weijden GA. The efficacy of oral irrigation in addition to a toothbrush on plaque and the clinical parameters of periodontal inflammation: a systematic review. Int J Dent Hyg. 2008 Nov;6(4):304-14.

11. Sakellari, D., Arapostathis, K. N. and Konstantinidis, A. Periodontal conditions and subgingival microflora in Down syndrome patients. Journal of Clinical Periodontology 2005, 32: 684–690.

12. Reuland-Bosma, W. and van Dijk, J. Periodontal disease in Down's syndrome: a review. Journal of Clinical Periodontology 1986, 13: 64–73.

13. Santos, R., Shanfeld, J. and Casamassimo, P., Serum antibody response to *Actinobacillus actinomycetemcomitans* in Down's syndrome. Special Care in Dentistry. 1996 16: 80–83.

14. M. H. Tanaka & T. O. Rodrigues & L. S. Finoti & S. R. L. Teixeira & M. P. A. Mayer &
R. M. Scarel-Caminaga & E. M. A. Giro. The effect of conventional mechanical periodontal treatment on red complex microorganisms and clinical parameters in Down syndrome periodontitis patients: a pilot study . Eur J Clin Microbiol Infect Dis (2015) 34:601–608.

15. Ronald H.W. Cheng,W. Keung Leung, and Esmonde F. Corbet. Non-Surgical Periodontal Therapy With Adjunctive Chlorhexidine Use in Adults With Down Syndrome: A Prospective Case Series. J Periodontol 2008 Feb;79(2):379-85.

16. R.M. Zaldivar-Chiapa, Dr. A.Y. Arce-Mendoza, M. De La Rosa-Ramírez, R.G. Caffesse, J.M. Solis-Soto. Evaluation of Surgical and Non-Surgical Periodontal

Therapies, and Immunological Status, of Young Down's Syndrome Patients. J Periodontol July 2005, Vol. 76, No. 7, Pages 1061-1065

17. Morgan J. Why is periodontal disease more prevalent and more severe in people with Down syndrome? Spec. Care Dentist. 2007 Sep-Oct;27(5):196-201

18. Yoshihara T, Morinushi T, Kinjyo S, Yamasaki Y. Effect of periodic preventive care on the progression of periodontal disease in young adults with Down's syndrome.
J Clin Periodontol 2005; 32: 556–560

19. Khocht A, Janal M, Turner B. Periodontal health in Down syndrome: contributions of mental disability, personal, and professional dental care. Spec. Care Dentist 2010 May-Jun;30(3):118-23

20. Amaral Loureiro AC, Oliveira Costa F, Eustaquio da Costa J. The impact of periodontal disease on the quality of life of individuals with Down syndrome. Downs Syndr Res Pract 2007;12:50-4.

21. Alrayyes S, Hart TC. Periodontal disease in children. Dis Mon 2011;57:184-91.

22. Prakasam A, Elavarasu SS, Natarajan RK. Antibiotics in the management of aggressive periodontitis. J Pharm Bioallied Sci 2012;4(suppl 2):S252-S255.

23. Cheng RH, Leung WH, Corbet EF. Non-surgical periodontal therapy with adjunctive chlorhexidine use in adults with down syndrome: a prospective case series. J Periodontol 2008 Feb;79(2):379-85.

5. NON SURGICAL PERIODONTAL THERAPY

Control of sub-gingival bacterial plaque

Root planing has been shown to cause a transient change in the composition of the subgingival plaque. Studies have demonstrated the change through a reduction of Gram- bacterial species and a concomitant increase of gram-positive bacterial species that are associated with gingival health condition. (Listgarten et al. 1978 Sbordone et al. 1990 Haffajee et al. 1997a, Stelzel & Flore`s-de-Jacoby 2000 Chaves et al. 2000). Recently, Haffajee et al. (1997a, b) and Cousins et al. (2000) reported that scaling and root planing resulted in significant decreases in the counts of DNA probes of a specific subset of microbes subgingival, including Porphyromonas gingivalis, Treponema forsythus Bacteroides and denticola. In conjunction with decreases in this subgroup of bacteria were significant increases Actinomyces sp., Capnocytophaga sp., Fusobacterium nucleatum subsp. polymorphum, Streptococcus mitis, and Veillonella parvula. Results similar projection decreased levels of P. gingivalis and T. denticola were reported by Ali et al. (1992), Simonson et al. (1992), Shiloah and Patters (1994), and Lowenguth et al. (1995). Although spirochetes, microbes motility and Bacteroides sp. are regularly reduced in numbers after scaling and root planing, other species appear to be more resistant, such as Actinobacillus actinomycetemcomitans and P. gingivalis (Siloam & Patters 1994 Troil von-Linde 'n et al., 1996 Haffajee et al. 1997a).

Some bacteria have proven to be more difficult to eradicate. In particular, A. actinomycetemcomitans, P. gingivalis. The difficulty in the eradication is in part explained by the A.A. ability to invade the epithelium and periodontal tissues (Sato et al., 1993 Mombelli et al. 2000). Surviving protected from the tissues in which they are penetrated these bacteria may

represent the "reservoir" that can trigger a relapse after periodontal therapy. (Slot & Rosling 1983 Christersson et al. 1985 Shiloah 1994 Mombelli 1994) These bacteria are in fact associated with the lack of positive response to periodontal treatment. Patients so-called "refractory" in fact show the persistence of bacteria such as AA and Pg even after therapy (Daly et al., 1982 Adriaens et al., 1988, Giuliana et al. 1997).

To obtain stable changes in the bacterial flora of the oral cavity it is seen that it is necessary that there is an optimal control of supragingival bacterial plaque. Also there are some niches of the oral cavity which are areas of accumulation of bacterial species that can re-colonize the pockets and cause a relapse. These niches are represented by the tongue and tonsils. Some studies have taken into account during the causal therapy with appropriate treatment the back of the tongue and irrigation with chlorexidina to eliminate bacteria from these niches.The supportive periodontal treatment aims to control supra gingival plaque accumulation (Westfelt et al., 1983 Lindhe & Nyman 1984 Harper & Robinson 1987 van Winkelhoff et al. 1988 Renvert et al. 1990a, Shiloah and Patters 1996, Cobb et al 2002)

Removal of sub-gingival calculus

“The concept of removing all sub-gingival calculus and contaminated cementum has been shown to be unrealistic and quite likely unnecessary”(Borghetti et al. 1987, Breininger et al. 1987, Eschler & Rapley 1991, Fukazawa & Nishimura 1994).The complete calculus removal not only seems to be unrealistic, but also unnecessary. It has been seen that the presence of tartar remnants on the root surface are compatible with the obtaining of a state of gingival health. (Nyman et al. 1986 Bloemhof et al., 1987 Buchanan & Robertson 1987)

Even the intentional removal of the root cement is today to view in a different manner. Previously it was believed necessary to remove the root cementum because it was believed that the LPS

were closely connected to the root surface. But today we know that there is a weak link and that the cementum should not be instrumented excessively. Numerous studies have demonstrated that the sonic and ultrasonic instrumentation lead to similar results to those obtained with hand instruments. (Badersten et al. 1981, 1984a, 1984b, Nyman et al. 1986 Checchi & Pelliccioni 1988 Cheetham et al., 1988, Smart et al., 1990 Chiew et al. 1991 1990 Copulos Laurell et al. 1993) . (Cobb C.M. 2002)

Manual and sonic/ultrasonic instrumentation

Numerous studies have shown comparable efficacy between the manual and the ultrasonic instrumentation in terms of calculus removal and consequent improvement in clinical parameters of periodontal disease. The ultrasonic instrumentation, however, seems to be equally effective in less time, with a saving of time which seems to be between 20-50% (Badersten et al. 1981, 1984a, 1985a, Loos et al. 1987, 1989, Checchi & Pelliccioni 1988, Kawanami et al. 1988, Laurell & Pettersson 1988, Laurell 1990, Dragoo 1992, Copulos et al. 1993, Grant et al. 1993, Boretti et al. 1995, Drisko 1995, Kocher et al. 1997, Yukna et al. 1997Checchi&Pelliccioni 1988, Dragoo 1992, Copulos et al. 1993, Drisko 1995).

The complete calculus removal is closely linked to the root surface morphology/anatomy and to the pockets depth. Obviously PPD increases with increasing the proportion of non removed calculus (Waerhaug 1978a, 1978b). In fact, Stambaugh et al. (1981) noted that the removal of all plaque and subgingival calculus was unlikely to occur when the average probing pocket depth were 3.73 mm. In particular 2 studies have been conducted in order to compare the efficacy of ultrasonic instruments with standard tips versus ultrasonic instruments with very thin tips. The results were controversial because according to the study of Dragoo 1992 is not possible with any type of tip reach the bottom of deep pockets, while according to Clifford et al. (1999) both of the ultrasonic tip types were able to reach the bottom of the examined periodontal pockets.

Although studies in the literature report these partial effectiveness of etiological therapy since no instrument has proved to be completely able to remove all the etiological agents, the etiological treatment was demonstrated to be effective in the control of periodontal disease in the short and long term. This can be explained through the concept of 'critical mass' (WWP 1989). "As applied to non-surgical periodontal therapy, the concept of critical mass is becoming better understood that a major goal of periodontal therapy is to reduce the amount (mass) of bacterial plaque to a level (critical) that results in a balance between the residual microbes and the host response, that is, no clinical disease. Given the physical limitations, both anatomical and instrumental, of subgingival scale and / or root planing, it can be argued that it is extravagant to suppose that doctors can remove all subgingival plaque and tartar ".(Cobb C.M. 2002)

Root surface smoothness

The importance of obtaining a smooth root surface has been a controversial topic for a long time. In the past it was believed that the root surface should be smooth in order to be biocompatible and to obtain a state of health. This idea was born from the studies conducted earlier by Waerhaug (1956) on experimental animals and later by other authors (Keenan et al. 1980 Budtz-Jorgensen & Kaaber 1986 Quirynen & Listgarten 1990 Leknes et al. 1996) which showed an association between the root surface roughness and plaque accumulation. According to these authors the smoothness of the root surfaces obtained by root planing allowed to have biocompatible surfaces and to improve clinical parameters. Conversely Rosenberg & Ash (1974) and subsequently Khatiblou & Ghodssi (1983) and Oberholzer & Rateitschak (1996) found no correlation between the presence of smooth root surfaces and periodontal health status. According to the studies of Quirynen et al., 1993 and Bollen et al. 1996a surfaces with a roughness greater than the 0.2 mm threshold are associated with an increase in the retention of bacterial plaque.

An important in vitro study by Schlageter et al. (1996) has allowed to obtain a scale of roughness of root surfaces produced with the use of different and manual and rotating and / or sonic and ultrasonic instruments. The surprising result was that independent of the instrument is not possible to obtain a root surface with a roughness value of less than 1.6 mm. This means that at present with the available instruments we are not able in any way to make the root surface smooth enough to reduce bacterial colonization. In other words we can say that obtain a smooth root surface is an unrealistic goal of the periodontal therapy.

Nonsurgical therapy

The objective of non-surgical periodontal therapy is to remove by means of manual and ultrasonic instruments the supra and the subgingival calculus. The calculus elimination causes a change in the composition of bacterial plaque and a consequent improvement in clinical parameters and in the reduction of the inflammation signs. This, as we have already said, is compatible with the presence of a certain amount of calculus residual and is independent of the type of instrument used.

The root planing leads to good results even if there are some factors limiting the desired gingival health status . The percentage of residual calculus after root planing ranges from 3% to 80% depending on the root surface considered. (Mongardini et al 1999)

In particular it is seen that the deep pockets and the furcation defects represent areas of difficult access for the instruments, and then are areas with the greatest risk of persistence of clinical signs of inflammation. One study (Wylam 1983) evaluated the instrumentation of compromised molar furcations with an open flap approach versus a closed non surgical treatment and found that in both groups the use of motor instruments has been proven to be more effective in terms of calculus elimination . Today on the market are available ultrasonic tips with very small dimensions designed to get into the small area of access of bifurcations.

The result of non-surgical periodontal therapy has also proved closely related to the skill and experience of the operator. (Kocher et al 1997).
Even the over-instrumentation of root surfaces obtained with numerous and vigorous curettes strokes has proven useless and harmful. An over-instrumentation can indeed lead to excessive dentine hypersensitivity very troublesome for the patient even up to cause pulpitis (Fukazawa 1994)

The objective of non-surgical periodontal therapy is to obtain a clinical attachment gain through a probing pocket depth reduction and an increase of the gingival recession. Several studies showed that in presence of pockets depth between 4-6 mm, root planing is effective both in term of PPD reduction and in term of CAL gain. In presence of pockets with more than 7 mm depth we obtained a reduction of PPD and a significant CAL gain. The pocket closure and the clinical attachment gain is proportional to the initial probing pocket depth. Otherwise the sites with a probing depth of between 1 and 3 mm showed attachment loss when subjected to root planing and therefore should be treated only with scaling. (Knoweles 1979 ,1996 Pihlstrom 1983 Becker 2001).Teeth with furcations involvement showed a worse prognosis than single-rooted elements after periodontal treatment (Kalkwarf 1988).
To obtain significantly positive results with non-surgical therapy is necessary, in addition to subgingival instrumentation, achieve optimum supragingival plaque control. In fact, in presence of lack of oral hygiene, the transitional change in the subgingival microbiota,induced by the disruption of the biofilm, is lost in a short time and we observed the recurrence of a periodontal pathogenic bacterial flora.
Studies conducted by Badersten have shown that it is possible to obtain thanks to the periodontal treatment (i.e.scaling and root planing) associated with optimal level of oral hygiene a reduction in bleeding index <20% regardless of the initial depth of the pocket. These results can be successfully maintained stable in the next 2 years.

Non surgical therapy can be accomplished by different kind of instruments: hand instruments, sonic/ultrasonic instrument e rotary instruments.

Hand instrument are basically the curettes: Universal curettes with 2 working parts for each side or Gracey curettes with only one cutting part for side. The dimension of the blade could be standard or mini.
Sonic scalers use air pressure to create mechanical vibration.
Ultrasonic instruments can be piezoelectric or magnetostrictive. The piezoelectric scaler vibration is linear while the magnetostrictive is elliptical.
Fine grained diamond burs can be used for root planing usually during open flap curettage.

The re-evaluation after cause related therapy is performed after 3 months. This period correspond to the connective tissue healing period. Measurements performed at baseline(before treatment) and after therapy, at least after 3 months are:

- plaque index
- bleeding score
- PPD probing pocket depth(distance between gingival margin and the tip of the probe inside the sulcus/pocket)

-REC gingival recession (distance between most apical extension of the gingival margin and the CEJ)
CAL clinical attachment level (PPD+REC)

All these data have to be collected in a periodontal chart. Patients have to be carefully instructed to oral hygiene procedures. Patients have to be instructed and motivated because without patient compliance we can not expect a good final result.

Different approaches for non surgical therapy

Traditionally root debridement is performed in a quadrant-by-quadrant approach. The protocol consist of four weekly one hour root planning sessions with manual and ultrasonic devices under local anesthesia. This approach offers the advantage of being able to check the patient oral hygiene procedure and to reinforce instruction and motivation every week for one month. Bollen et al. , Mongardini et al. , Quirynen et al. studied the hypothesis that plaque control and root debridement might be enhanced by a concomitant full mouth disinfection . This initially involved scaling and root planing of all quadrants within 24 h in combination with the application of chlorhexidine to all intraoral niches for 2 months both in the dental surgery and at home. Compared to a conventional, quadrant-by-quadrant approach to nonsurgical treatment, clinical and microbiologic parameters showed improved results following periodontal debridement completed within 24 h combined with simultaneous and postoperative full-mouth disinfection. These results confirm those of a similar study by Bollen et al. The findings suggest that re-infection of treated sites during the healing phase may occur from remaining untreated sites, or from other niches in the oral cavity. Quirynen et al., studied the relative importance of the use of chlorhexidine in the full-mouth disinfection. Clinical and microbiologic results from the studies indicated that chlorhexidine had no adjunctive effects. However, its use may be advisable in patients with a low compliance and because it aids initial healing.Another consideration in relation to non-surgically performed SRP is the extent of root instrumentation required for periodontal healing. The original intention with SRP was not only to remove microbial biofilm and calculus but also ‘‘contaminated’’ root cementum or dentin in order to prepare a root surface biocompatible for soft-tissue healing. The rationale for performing root planing was based on the concept that bacterial endotoxins penetrate into the cementum (Aleo et al. 1974), a concept that was later disproved by data from experimental studies showing that the endotoxins were loosely adhering to the surface of the root cementum and not penetrating into it .Hence, intentional removal of tooth structures by root planing during pocket/root instrumentation may not be considered as a prerequisite for periodontal healing (Nyman et al. 1986, 1988). Consequently,

pocket/root instrumentation should preferably be carried out with instruments that cause minimal root substance removal, but are effective in disrupting the biofilm and removing calculus. In this respect, data reported in studies that evaluated root substance removal following the use of various manual and power-driven instruments encourage the use of ultrasonic devices. This is the rationale of the full mouth ultrasonic debridement proposed by Wennstrom et al 2005 consisting of a single one hour ultrasonic session of full mouth sub gingival debridement. This approach has been demonstrated to be effective as the traditional one but in a shorter chair-time e with less discomfort for the patient.

REFERENCES

1) Adriaens, P. A., De Boever, J. A. & Loesche, W. J. (1988) Bacterial invasion in root cementum and radicular dentin of periodontally diseased teeth in humans. Journal of Periodontology 59, 222–230

2)Aleo JJ, De Renzis FA, Farber PA. In vitro attachment of Auman gingival fibroblasts to root surface. J Periodontol 1975: 46: 639–645.

3)Ali, R. W., Lie, T. & Skaug, N. (1992) Early effects of periodontal therapy on the detection frequency of four putative periodontal pathogens in adults. Journal of Periodontology 63, 540–547.

4)Al-Joburi, W., Quee, T. C., Lautar, C., Iugovaz, I., Bourgouin, J., Delorme, F. &Chan, E. C. S. (1989) Effects of adjunctive treatment of periodontitis with tetracycline and spiramycin. Journal of Periodontology 60, 533–539.

5)Anderson, G. B., Palmer, J. A., Bye, F. L., Smith, B. A. & Caffesse, R. G. (1996) Effectiveness of subgingival scaling and root planing: Single versus multiple episodes of instrumentation. Journal of Periodontology 67, 367–373.

6)Axelsson, P. & Lindhe, J. (1981a) Effect of controlled oral hygiene procedures on caries and periodontal disease in adults. Results after six years. Journal of Clinical Periodontology 8, 239–248.

7)Axelsson, P. & Lindhe, J. (1981b) The significance of maintenance care in the treatment of periodontal disease. Journal of Clinical Periodontology 8, 281–294.

8)Badersten, A., Nilvus, R. & Egelberg, J. (1981) Effect of nonsurgical periodontal therapy. I. Moderately advanced periodontitis. Journal of Clinical Periodontology 8, 57–72.

9)Badersten, A., Nilveus, R. & Egelberg, J. (1984a) Effect of nonsurgical periodontal therapy. II. Severely advanced periodontitis. Journal of Clinical Periodontology 11, 63–76.

10)Badersten, A., Nilveus, R. & Egelberg, J. (1984b) Effect of nonsurgical periodontal therapy. III. Single versus repeated instrumentation. Journal of Clinical Periodontology 11, 114–124.

11)Baehni, P., Thilo, B., Chapuis, B. & Pernet, D. (1992) Effects of ultrasonic and sonic scalers on dental plaque microflora in vitro and in vivo. Journal of Clinical Periodontology 19, 455–459.

12)Becker, W., Becker, B. E., Ochsenbein, C., Kerry, G., Caffesse, R., Morrison, E. C. & Prichard, J. (1988) A longitudinal study comparing scaling, osseous surgery and modified Widman procedures. Results after one year. Journal of Periodontology 59, 351–365.

13)Blomlof, L., Lindskog, S., Appelgren, R., Jonsson, B., Weintraub, A. & Hammarstrom, L. (1987) New attachment in monkeys with experimental periodontitis with and without removal of the cementum. Journal of Clinical Periodontology 14, 136–143.

14)Bollen, C. M. L., Mongardini, C., Papaioannou, W., van Steenberghe, D. & Quirynen, M. (1998) The effect of a one-stage fullmouth disinfection on different intra-oral niches. Clinical and microbiological observations. Journal of Clinical Periodontology 25, 56–66.

15)Bollen, C. M. L. & Quirynen, M. (1996) Microbiological response to mechanical

treatment in combination with adjunctive therapy. A review of the literature. Journal of Periodontology 67, 1143–1158.

16)Bollen, C. M. L., Vandekerckhove, B. N. A., Papaioannou, W., Van Eldere, J. & Quirynen, M. (1996b) Full- versus partial- mouth disinfection in the treatment of periodontal infections. A pilot study: Long-term microbiological observations. Journal of Clinical Periodontology 23, 960–970.

17) Boretti, G., Zappa, U., Graf, H. & Case, D. (1995) Short-term effects of phase 1 therapy on crevicular cell populations. Journal of Periodontology 66, 235–240.

18)Borghetti, A., Mattout, P. & Mattout, C. (1987) How much root planing is necessary to remove the cementum from the root surface? International Journal of Periodontics and Restorative Dentistry 4, 22–29.

18)Breininger, D. R., O'Leary, T. J. & Blumenshine, R. V. H. (1987) Comparative effectiveness of ultrasonic and hand scaling for the removal of subgingival plaque and calculus. Journal of Periodontology 58, 9–18.

19)Buchanan, S. A. & Robertson, P. B. (1987) Calculus removal by scaling and root planing with and without surgical access. Journal of Periodontology 58, 159–163.

20)Caffesse, R. G., Sweeney, P. L. & Smith, B. A. (1986) Scaling and root planing with and without periodontal flap surgery. Journal of Clinical Periodontology 13, 205–210.

21)Caton, J. G., Proye, M. & Polson, A. (1982) Maintenance of healed periodontal pockets after a single episode of root planing. Journal of Periodontology 53, 420–424.

22)Cercek, J. F., Kiger, R. D., Garrett, S. & Egelberg, J. (1983) Relative effects of

plaque control and instrumentation on the clinical parameters of human periodontal disease. Journal of Clinical Periodontology 10, 46–56.

23)Chaves, E. S., Jeffcoat, M. K., Ryerson, C. C. & Snyder, B. (2000) Persistent bacterial colonization of Porphyromonas gingivalis, Prevotella intermedia, and Actinobacillus actinomycetemcomitans in periodontitis and its association with alveolar bone loss after 6 months of therapy. Journal of Clinical Periodontology 27, 897–903.

24)Checchi, L., Forteleoni, G., Pelliccioni, G. A. & Loriga, G. (1997) Plaque removal with variable instrumentation. Journal of Clinical Periodontology 24, 715–717.

25)Checchi, L. & Pelliccioni, G. A. (1988) Hand versus ultrasonic instrumentation in the removal of endotoxins from root surfaces in vitro. Journal of Periodontology 59, 398–402.

26)Cheetham, W. A., Wilson, M. & Kieser, J. B. (1988) Root surface debridement — an in vitro assessment. Journal of Clinical Periodontology 15, 288–292.

27)Chiew, S. Y., Wilson, M., Davies, E. H. &Kieser, J. B. (1991) Assessment of ultrasonic debridement of calculus-associated periodontally-involved root surfaces by the limulus amoebocyte lysate assay. An in vitro study. Journal of Clinical Periodontology 18, 240–244.

28)Christersson, L. A., Slots, J., Rosling, B. & Genco, R. (1985) Microbiological and clinical effects of surgical treatment of localized juvenile periodontitis. Journal of Clinical Periodontology 12, 465–476.

29)Claffey, N. & Egelberg, J. (1995) Indicators of probing attachment loss following

initial periodontal treatment in advanced periodontitis patients. Journal of Clinical Periodontology 22, 690–696.

30)Claffey, N., Loos, B., Gantes, B., Martin, M., Heins, P. & Egelberg, J. (1988) The relative effects of therapy and periodontal disease on loss of probing attachment after root debridement. Journal of Clinical Periodontology 15, 163–169.

Claffey N., Polyzois i., Ziaka P. (2004)An overview of nonsurgical and surgical therapy Periodontology 2000, vol 36, 35-44

31)Clifford, L. R., Needleman, I. G. & Chan, Y. K. (1999) Comparison of periodontal pocket penetration by conventional and microultrasonic inserts. Journal of Clinical Periodontology 26, 124–130.

32)Cobb, C. M. (1996) Non-surgical pocket therapy: Mechanical. Annals of Periodontology 1, 443–490. Coldiron, N. B., Yukna, R. A., Weir, J. &

Cobb C M: Clinical significance of non-surgical periodontal therapy: an evidence-based perspective of scaling and root planing. J Clin Periodontol 2002; 29 (Suppl 2): 6–16.

33)Caudill, R. F. (1990) A quantitative study of cementum removal with hand curettes. Journal of Periodontology 61, 293–299.

34)Copulos, T. A., Low, S. B., Walker, C. B., Trebilcock, Y. Y. & Hefti, A. F. (1993) Comparative analysis between a modified ultrasonic tip and hand instruments on clinical parameters of periodontal disease. Journal of Periodontology 64, 694– 700.

35)Cugini, M. A., Haffajee, A. D., Smith, C., Kent, R. L. Jr & Socransky, S. S. (2000)

The effect of scaling and root planing on the clinical and microbiological parameters of periodontal diseases: 12-month results. Journal of Clinical Periodontology 27, 30–36.

36)Dahle«n, G., Lindhe, J., Sato, K., Hanamura, H. & Okamoto, H. (1992) The effect of supragingival plaque control on the composition of the subgingival flora in periodontal pockets. Journal of Clinical Periodontology 19, 802–809.

37)Daly, C., Seymour, G., Kieser, J. & Corbet, E. (1982) Histological assessment of periodontally involved cementum. Journal of Clinical Periodontology 9, 266–274.

38)Dragoo, M. R. (1992) A clinical evaluation of hand and ultrasonic instruments on subgingival debridement. 1. With unmodified and modified ultrasonic inserts. International Journal of Periodontics and Restorative Dentistry 12, 310–323.

39)Drisko, C. L. (1995) Periodontal debridement: Hand versus power-driven scalers. Dental Hygiene News 8, 18–23.

40)Drisko, C. L., Cobb, C. M., Killoy, W. J., Michalowicz, B. S., Pihlstrom, B. L., Lowenguth, R. et al. (1995) Evaluation of periodontal treatments using controlled- release tetracycline fibers: Clinical response. Journal of Periodontology 66, 692–699.

41)Eaton, K. A., Kieser, J. B. & Davies, R. M. (1985) The removal of root surface deposits. Journal of Clinical Periodontology 12, 141–152.

Egelberg J. Periodontics. In: The scientific way. Synopses of clinical studies, 3rd edn. Malmo, Sweden: OdontoScience, 1999.

42) Fukazawa, E. & Nishimura, K. (1994) Superficial cemental curettage: its efficacy in promoting improved cellular attachment on human root surfaces previously damaged by periodontitis. Journal of Periodontology 65, 168–176.

43)Garrett, S., Johnson, L., Drisko, C. H., Adams, D. F., Bandt, C., Beiswanger, B. et al. (1999) Two multi-center studies evaluating locally delivered doxycycline hyclate, placebo, control, oral hygiene, and scaling and root planing in the treatment of periodontitis. Journal of Periodontology 70, 490–503.

44)Giuliana, G., Ammatuna, P., Pizzo, G., Capone, F. & D'Angelo, M. (1997) Occurrence of invading bacteria in radicular dentin of periodontally diseased teeth: Microbiological findings. Journal of Clinical Periodontology 24, 478– 485.

45)Haffajee, A. D., Cugini, M. A., Dibart, S., Smith, C., Kent, R. L. Jr & Socransky, S. S. (1997a) The effect of SRP on the clinical and microbiological parameters of periodontal diseases. Journal of Clinical Periodontology 24, 324–334.

46)Haffajee, A. D., Cugini, M. A., Dibart, S., Smith, C., Kent, R. L. Jr & Socransky, S. S. (1997b) Clinical and microbiological features of subjects with adult periodontitis who responded poorly to scaling and root planing. Journal of Clinical Periodontology 24, 767–776.

47)Haffajee, A. D. & Socransky, S. S. (1994) Microbial etiological agents of destructive periodontal diseases. Periodontology 2000 5, 78–111.

48)Hammerle, C. H. F., Joss, A. & Lang, N. P. (1991) Short term effects of initial periodontal therapy (hygienic phase). Journal of Clinical Periodontology 18, 233– 239.

49)Harper, S. & Robinson, P. (1987) Correlation of histometric, microbial, and clinical indicators of periodontal disease status before and after root planing. Journal of Clinical Periodontology 14, 190–196.

50)Hinrichs, J., Wolff, L., Pihlstrom, B., Schaffer, E. M., Siljemark, W. F. & Brand, T. C. L. (1985) Effects of scaling and root planing on subgingival microbial proportions standardized in terms of their naturally occurring distribution. Journal of Periodontology 56, 187–194.

51)Hughes, T. P. & Caffesse, R. G. (1978) Gingival changes following scaling and root planing and oral hygiene. A biometric evaluation. Journal of Periodontology 49, 245–252.

52)Hunter, R. D., O'Leary, T. J. & Kafrawy, A. T. (1984) The effectiveness of hand versus ultrasonic instrumentation in open flap root planing. Journal of Periodontology 55, 697–703.

53)Isidor, F. & Karring, T. (1986) Long-term effect of surgical and nonsurgical periodontal treatment. A 5-year clinical study. Journal of Periodontal Research 21, 462– 472.

54)Isidor, F., Karring, T. & Attstrom, R. (1984) The effect of root planing as compared to that of surgical treatment. Journal of Clinical Periodontology 11, 669– 681.

55)Jeffcoat, M. K., Bray, K. S., Ciancio, S. G., Dentino, A. R., Fine, D. H., Gordon, J. M. et al. (1998) Adjunctive use of a subgingival controlled-release chlorhexidine chip reduces probing depth and improves attachment level compared with scaling and root planing alone. Journal of Periodontology 69, 989–997.

56)Jotikasthira, N., Lie, T. & Leknes, K. (1992) Comparative in vitro studies of sonic, ultrasonic and reciprocating scaling instruments. Journal of Clinical Periodontology 19, 560–569.

57)Kaldahl, W. B., Kalkwarf, K. L., Patil, K. D., Dyer, J.K.&Bates, R. E. (1988) Evaluation of four modalities of periodontal therapy. Mean probing depth, probing attachment level and recession changes. Journal of Periodontology 59, 783–793.

58)Kaldahl, W. B., Kalkwarf, K. L., Patil, K. D., Molvar, M. P. & Dyer, J. K. (1996a) Long-term evaluation of periodontal therapy. I. Response to 4 therapeutic modalities. Journal of Periodontology 67, 93–102.

59)Kaldahl, W. B., Kalkwarf, K. L., Patil, K. D., Molvar, M. P. & Dyer, J. K. (1996b) Longterm evaluation of periodontal therapy. II.mIncidence of sites breaking down. Journal of Periodontology 67, 103–108.

60)Kalkwarf, K. L., Kaldahl, W. B., Patil, K. D. & Molvar, M. P. (1989) Evaluation of gingival bleeding following 4 types of periodontal therapy. Journal of Clinical Periodontology 16, 601–608.

61)Katsanoulas, T., Renee, I. & Attstrom, R. (1992) The effect of supragingival plaque control on the composition of the subgingival flora in periodontal pockets. Journal of Clinical Periodontology 19, 760–765.

62)Kawanami, M., Sugaya, T., Kato, S., Iinuma, K., Tate, T., Hannan, M. A. & Kato, H. (1988) Efficacy of an ultrasonic scaler with a periodontal probe-type tip in deep periodontal pockets. Advances in Dental Research 2, 405–410.

63)Keenan, M. P., Schillingburg, H. T., Duncanson, M. G. & Wade, C. K. (1980) Effects of cast gold surface finishing on plaque retention. Journal of Prosthetic Dentistry 43, 168–173.

64)Kepic, T. J., O'Leary, T. J. & Kafrawy, A. H. (1990) Total calculus removal: An attainable objective? Journal of Periodontology 61, 16–20.

65)Khatiblou, F. A. & Ghodssi, A. (1983) Root surface smoothness or roughness in periodontal treatment. A clinical study. Journal of Periodontology 54, 365– 367.

66)Kinane, D. F. & Radvar, M. (1999) A six month comparison of three periodontal local antimicrobial therapies in persistent periodontal pockets. Journal of Periodontology 70, 1–7.

67)Klinge, B., Attstro¬m, R., Karring, T., Kisch, J., Lewin, B. & Stoltze, K. (1992) 3 regimens of topical metronidazole compared with subgingival scaling on periodontal pathology in adults. Journal of Clinical Periodontology 19, 708–714.

68)Knowles, J. W., Burgett, F. G., Nissle, R. R., Shick, R. A., Morrison, E. C. & Ramfjord, S. P. (1979) Results of periodontal treatment related to pocket depth and attachment level. Eight years. Journal of Periodontology 50, 225–233.

69)Kocher, T., Gutsche, C. & Plagmann, H.-C. (1998a) Instrumentation of furcation with modified sonic scaler inserts: Study on manikins, Part I. Journal of Clinical Periodontology 25, 388–393.

70)Kocher, T., Ru¬hling, A., Momsen, H. & Plagmann, H.-C. (1997) Effectiveness of subgingival instrumentation with powerdriven instruments in the hands of experienced and inexperienced operators. A study on manikins. Journal of Clinical Periodontology 24, 498–504.

71)Lang, N. P., Joss, A., Orsanic, T., Gusberti, F. A. & Siegrist, B. E. (1986) Bleeding on probing: a predictor for the progression of periodontal disease? Journal of Clinical Periodontology 13, 590–596.

72)Laurell, L. (1990) Periodontal healing after scaling and root planing with the Kavo Sonicflex and Titan-S sonic scalers. Swedish Dental Journal 14, 171–177.

73)Laurell, L.&Pettersson,B. (1988) Periodontal healing after treatment with either theTitan-S sonic scaler or hand instruments. Swedish Dental Journal 12, 187–192.

74)Lavanchy, D., Bickel, M. & Bachni, P. (1987) The effect of plaque control after scaling and root planing on the subgingival microflora in human periodontitis. Journal of Clinical Periodontology 14, 295–299.

75)Leknes, K. N., Lie, T., Wikesjo , U. M. E., Boe, O. E. & Selvig, K. A. (1996) Influence of tooth instrumentation roughness on gingival tissue reactions. Journal of Periodontology 67, 197–204.

76)Leon, L. E. & Vogel, R. I. (1987) A comparison of the effectiveness of hand scaling and ultrasonic debridement in furcations as evaluated by differential dark-field microscopy. Journal of Periodontology 58, 86–94.

77)Lie, T. & Leknes, K. N. (1985) Evaluation of the effect on root surfaces of air turbine scalers and ultrasonic instrumentation. Journal of Periodontology 56, 522–531.

78)Lindhe, J. & Nyman, S. (1984) Long-term maintenance of patients treated for advanced periodontal disease. Journal of Clinical Periodontology 11, 504–514.

79)Lindhe, J. & Nyman, S. (1985) Scaling and granulation tissue removal in periodontal therapy. Journal of Clinical Periodontology 12, 374–388.

80)Lindhe, J., Socransky, S., Nyman, S. & Westfelt, E. (1987) Dimensional alterations

of the periodontal tissues following therapy. International Journal of Periodontics and Restorative Dentistry 7, 9–21.

81)Lindhe, J., Westfelt, E., Nyman, S., Socransky, S. S. & Haffajee, A. D. (1984) Longterm effect of surgical/nonsurgical treatment of periodontal disease. Journal of Clinical Periodontology 11, 448–458.

82)Lindhe, J., Westfelt, E., Nyman, S., Socransky, S., Heijl, L. & Bratthall, G. (1982) Healing following surgical/nonsurgical treatment of periodontal disease. A clinical study. Journal of Clinical Periodontology 9, 115–128.

83)Listgarten, M. A., Lindhe, J. & Hellde«n, L. B. (1978) Effect of tetracycline and/or scaling on human periodontal disease. Clinical, microbiological and histological observations. Journal of Clinical Periodontology 5, 246–271.

84)Loos, B., Kiger, R. & Engelberg, J. (1987) An evaluation of basic periodontal therapy using sonic and ultrasonic scalers. Journal of Clinical Periodontology 14, 29–33.

85)Loos, B., Nylund, K., Claffey, N. & Egelberg, J. (1989) Clinical effects of root debridement in molar and non-molar teeth. Journal of Clinical Periodontology 16, 498–504.

86) Magnusson, I., Lindhe, J., Yoneyama, T. & Liljenberg, B. (1984) Recolonization of a subgingival microbiota following scaling in deep pockets. Journal of Clinical Periodontology 11, 193–207.

87)Machtei, E. E., Schmidt, M., Hausmann, E., Grossi, S., Dunford, R., Chandler, J. & Genco, R. J. (2000) Outcome variables in periodontal research: means and threshold based site changes. Journal of Periodontology 71, 555–561.

88)Mombelli, A., Gmur, R., Gobbi, C. & Lang, N. P. (1994a) Actinobacillus actinomycetemcomitans in adult periodontitis. I. Topographic distribution before and after treatment. Journal of Periodontology 65, 820–826.

89)Mombelli, A., Gmur, R., Gobbi, C. & Lang, N. P. (1994b) Actinobacillus actinomycetemcomitans in adult periodontitis. II. Characterization of isolated strains and effect of mechanical periodontal treatment. Journal of Periodontology 65, 827–834.

90)Mombelli, A., Schmid, B., Rutar, A. & Lang, N. P. (2000) Persistence patterns of Porphyromonas gingivalis, Prevotella intermedia/ nigrescens, and Actinobacillus actinomycetemcomitans after mechanical therapy of periodontal disease. Journal of Periodontology 71, 14–21.

91)Mongardini, C., van Steenberghe, D., Dekeyser, C. & Quirynen, M. (1999) One state full- versus partial-mouth disinfection in the treatment of chronic adult or generalized early-onset periodontitis. I. Long-term clinical observations. Journal of Periodontology 70, 632–645.

92)Morrison, E. C., Ramfjord, S. P. & Hill, R. W. (1980) Short term effects of initial nonsurgical periodontal treatment (hygiene phase). Journal of Clinical Periodontology 7, 199–211.

93)Mousques, T., Listgarten, M. A. & Phillips, R. W. (1980) Effect of scaling and root planing on the composition of the human subgingival microbial flora. Journal of Periodontal Research 15, 144–151.

94)Newman, M. G., Kornman, K. S. & Doherty, F. M. (1994) A 6-month multi-center evaluation of adjunctive tetracycline fiber therapy used in conjunction with scaling and root planing in maintenance patients: Clinical results. Journal of Periodontology 65, 685–691.

Nordland P, Garrett S, Kiger R, Vanooteghem R, Hutchens LH, Egelberg J. The effect of plaque control and root debridement in molar teeth. J Clin Periodontol 1987: 14: 231–236.

95)Noyan, U., . Yilmaz, S., Kuru, B., Kadir, T., Acar, O. & Buget, E. (1997) A clinical and microbiological evaluation of systemic and local metronidazole delivery in adult periodontitis patients. Journal of Clinical Periodontology 24, 158–165.

96)Nyman, S. & Lindhe, J. (1979) A longitudinal study of combined periodontal and prosthetic treatment of patients with advanced periodontal disease. Journal of Periodontology 50, 163–169.

97)Nyman, S., Sarhed, G., Ericsson, I., Gottlow, J. & Karring, T. (1986) Role of 'diseased' root cementum in healing following treatment of periodontal disease. Journal of Periodontal Research 21, 496–503.

98)Oberholzer, R. & Rateitschak, K. H. (1996) Root cleaning or root smoothing. An in vivo study. Journal of Clinical Periodontology 23, 326–330.

99)Patterson, M., Eick, J. D., Eberhart, A. B., Gross, K. & Killoy, W. J. (1989) The effectiveness of two sonic and two ultrasonic scaler tips in furcations. Journal of Periodontology 60, 325–329.

100)Pihlstrom, B. L., McHugh, R. B. & Oliphant, T. H. (1984) Molar and nonmolar teeth compared over 6.5 years following two methods of periodontal therapy. Journal of Periodontology 55, 499–504.

101)Preshaw, P. M., Lauffart, B., Zak, E., Jeffcoat, M. K., Barton, I. & Heasman, P. A. (1999) Progression and treatment of chronic adult periodontitis. Journal of Periodontology 70, 1209–1220.

102)Proye, M., Caton, J. & Polson, A. (1982) Initial healing of periodontal pockets after a single episode of root planing monitored by controlled probing forces. Journal of Periodontology 53, 296–301.

103)Quirynen, M. & Bollen, C. M. L. (1995) The influence of surface roughness and surface-free energy on supra- and subgingival plaque formation in man. A review of the literature. Journal of Clinical Periodontology 22, 1–14.

104)Quirynen, M., Bollen, C. M. L., Papaioannou, W., Van Eldere, J. & van Steenberghe, D. (1996) The influence of titanium abutment surface roughness on plaque accumulation and gingivitis: Short-term observations. International Journal of Oral and Maxillofacial Implants 11, 69–178.

105)Quirynen, M., Bollen, C. M. L., Vandekerckhove, B. N. A., Dekeyser, C., Papaioannou, W. & Eyssen, H. (1995) Full- vs. partial-mouth disinfection in the treatment of periodontal infections: Short-term clinical and microbiological observations. Journal of Dental Research 74, 1459–1467.

Quirynen M, Mongardini C, de Soete M, Pauwels M, Coucke W, van Eldere J, van Steenberghe D. The role of chlorhexidine in the one stage full mouth disinfection treatment of patients with advanced adult periodontitis. Long term clinical and microbiological observations. J Clin Periodontol 2000: 27: 578–589.

106)Rabbani, G. M., Ash, M. M. & Caffesse, R. G. (1981) The effectiveness of subgingival scaling and root planing in calculus removal. Journal of Periodontology 52, 119–123.

107)Ramfjord, S. P., Caffesse, R. G., Morrison, E. C., Hill, R. W., Kerry, G. J., Appleberry,

E. A., Nissle, R. R. & Stults, D. L. (1987) 4 modalities of periodontal treatment compared over 5 years. Journal of Clinical Periodontology 14, 445–452.

108)Renvert, S., Nilveus, R., Dahlen, G., Slots, J. & Egelberg, J. (1990a) 5-year follow-up of periodontal intraosseous defects treated by root planing or flap surgery. Journal of Clinical Periodontology 17, 356–363.

109) Renvert, S.,Wikstrom, M., Dahle«n, G., Slots, J. & Egelberg, J. (1990b) Effect of root debridement on the elimination of Actinobacillus actinomycetemcomitans and Bacteroides gingivalis from periodontal pockets. Journal of Clinical Periodontology 17, 345–350.

110) Rosenberg, R. M. & Ash, M. M. Jr (1974) The effect of root roughness on plaque accumulation and gingival inflammation. Journal of Periodontology 45, 146–150.

111)Sato, K., Yoneyama, T., Okamoto, H., Dahlen, G. & Lindhe, J. (1993) The effect of subgingival debridement on periodontal disease parameters and the subgingival microbiota. Journal of Clinical Periodontology 20, 359–365.

112)Sbordone, L., Ramaglia, L., Gulletta, E. & Iacono, V. (1990) Recolonization of the subgingival microflora after scaling and root planing in human periodontitis. Journal of Periodontology 61, 579–584.

113)Schlageter, L., Rateitschak-Pluss, E. M. & Schwarz, J.-P. (1996) Root surface smoothness or roughness following open debridement. An in vivo study. Journal of Clinical Periodontology 23, 460– 464.

114)Sherman, P. R., Hutchens, L. H. Jr & Jewson, L. G. (1990b) The effectiveness of subgingival scaling and root planing. II. Clinical responses related to residual calculus. Journal of Periodontology 61, 9–15.

115)Sherman, P. R., Hutchens, L. H. Jr, Jewson, L. G., Moriarty, J. M., Greco, G. W. & McFall, W. T. (1990a) The effectiveness of subgingival scaling and root planing. I. Clinical detection of residual calculus. Journal of Periodontology 61, 3–8.

116)Shiloah, J. & Patters, M. R. (1996) Repopulation of periodontal pockets by microbial pathogens in the absence of supportive therapy. Journal of Periodontology 67, 130–139.

117)Slots, J., Mashimo, P. C., Levine, M. J. & Genco, R. J. (1979) Periodontal therapy in humans. Microbiological and clinical effects of a single course of periodontal scaling and root planing and of adjunctive tetracycline therapy. Journal of Periodontology 50, 495–509.

118)Slots, J. & Rosling, B. (1983) Suppressing of the periodontopathic microflora in localized juvenile periodontitis by systemic tetracycline. Journal of Clinical Periodontology 10, 465–486.

119)Soskolne, W. A., Heasman, P. A., Stabholz, A., Smart, G. J., Palmer, M., Flashner, M. & Newman, H. N. (1997) Sustained local delivery of chlorhexidine in the treatment of periodontitis: a multi-center study. Journal of Periodontology 68, 32–38.

Stambaugh R, Dragoo M, Smith DM. The limits of subgingival scaling. Int J Periodontics Restorative Dent 1981: 1: 30– 41.

van der Velden U. Location of probe tip in bleeding and non-bleeding pockets with minimal gingival inflammation. J Clin Periodontol 1982: 9: 421–427.

120)von Troil-Linde«n, B., Saarela, M., Matto , J., Alaluusua, S., Jousimies-Somer, H. &

Asikainen, S. (1996) Source of suspected periodontal pathogens re-emerging after periodontal treatment. Journal of Clinical Periodontology 23, 601–607.

121)van Winkelhoff, A. J., Van der Velden, U. & de Graff, J. (1988) Microbial succession in recolonizing deep periodontal pockets after a single course of supraand subgingival debridement. Journal of Clinical Periodontology 15, 116– 122.

122)Vandekerckhove, B. N. A., Bollen, C. M. L., Dekeyser, C., Darius, P. & Quirynen, M. (1996) Full- versus partial-mouth disinfection in the treatment of periodontal infections. Long-term clinical observations of a pilot study. Journal of Periodontology 67, 1251–1259.

123)Waerhaug, J. (1956) Effect of rough surfaces upon gingival tissue. Journal of Dental Research 35, 323–325.

124)Waerhaug, J. (1978a) Healing of the dentoepithelial junction following subgingival plaque control. I. As observed in human biopsy material. Journal of Periodontology 49, 1–8.

125)Waerhaug, J. (1978b) Healing of the dentoepithelial junction following subgingival plaque control. II. As observed on extracted teeth. Journal of Periodontology 49, 119–134.

126)Westfelt, E., Bragd, L., Socransky, S., Haffajee, A., Nyman, S. & Lindhe, J. (1985) Improved periodontal conditions following therapy. Journal of Clinical Periodontology 12, 283–293.

127)Westfelt, E., Rylander, H., Dahle«n, G. & Lindhe, J. (1998)The effect of supragingival plaque control on the progression of advanced periodontal disease. Journal of Clinical Periodontology 25, 536– 541.

Wylam JM, Mealey BL, Mills MP. The clinical effectiveness of open versus closed scaling and root planing on multirooted teeth. J Periodontol 1993: 64: 1023–1028.

128)WWP (1989) Proceedings of the world workshop in clinical periodontics. Nevins, M., Becker, W. & Kornman, K. (eds) pp. 11–13. Princeton, New Jersey: American Academy of Periodontology.

129)Yukna, R. A., Scott, J. B., Aichelmann- Reidy, M. E., LeBlanc, D. M. & Mayer, E. T. (1997) Clinical evaluation of the speed and effectiveness of subgingival calculus removal on single-rooted teeth with diamond- coated ultrasonic tips. Journal of Periodontology 68, 436–442.

6. EXPERIMENTAL PROCEDURE

The aim of this study was to evaluate the clinical efficacy of a single session of full-mouth ultrasonic debridement (Fm-UD) as an initial periodontal treatment approach in comparison with the traditional treatment modality of consecutive sessions of Q-SRP in patient with DS.

MATERIALS AND METHODS

Study design

The trial was designed as a randomized, controlled, single-masked and parallel group study of 6 months duration, and was conducted at the " Servizio di Assistenza Odontoiatrica per Disabili" at the DIBINEM (UNIBO) from January 2013 to December 2015. Approval of the study protocol by the Local Ethics Committee was obtained, and all caregivers of the participating subjects received informed consent before the start of the study.

Patient sample

Forty patients, 20 patients for each group , with moderately advanced chronic periodontitis, were recruited for the study following a screening examination including full-mouth probing and radiographic evaluation. The following criteria were used in the selection of study subjects:

Inclusion criteria

-down syndrome patients

-Age 15-35 years;

-A minimum of 18 teeth;

- At least eight teeth must show probing pocket depths (PPD) of ≥ 5 mm and bleeding on probing (BOP).

Exclusion criteria

-Sub gingival instrumentation within 12 months prior to the baseline examination;

- Ongoing drug therapy that might affect the clinical signs and symptoms of periodontitis.

Sample size

Power calculation based on the detection of a difference in the mean PPD reduction of 0.5mm between treatment groups, assuming that the common standard deviation (SD) is 0.6 mm, and with an $\propto$ error defined to 0.05 and β error defined to 0.20, revealed that 20 subjects in each treatment group were required.

Examinations

Full-mouth clinical examinations were performed immediately before treatment (baseline) and 6 months following the completion of the baseline treatment protocol. All teeth and tooth sites, (except third molars) were included in the examinations.

The following variables were recorded at 4 aspect of each tooth (mesial, buccal, distal and lingual surfaces of each tooth):

-Plaque score (PS): presence/absence of plaque at the cervical part of the tooth scored by running a probe along the tooth surface.

- Bleeding on probing (BoP): presence/absence of bleeding within 15 s following pocket probing.

- Probing pocket depth (PPD): measured with a manual Hu– Friedy PCP 15 periodontal probe to the closest lower millimeter.

-Recession (REC): the distance between the GM and a fixed reference point on the tooth (cemento- enamel junction (CEJ)

-Clinical attachment level (CAL) was calculated as PPD+REC.

Furthermore the number of anesthetic's cartridges used for each patient was collected.

One examiner (a periodontist), who was masked with respect to the treatment assignments, performed all examinations.Before the study, the examiner was calibrated to reduce intraexaminer error (k>0.75) to establish reliability and consistency.

Randomization

A random assignment to the two treatment protocols was subsequently performed by the use of computer-generated tables. Based on the randomization procedure, 20 patients were assigned to the test treatment and 20 to the control treatment.Allocation concealment was achieved using a sealed coded opaque envelope containing the treatment of the specific subject. The sealed envelope containing treatment assignment was opened immediately before treatment.

FMUD–test

The patients assigned to this treatment group received, at baseline (Day 0), a 1-h session of full-mouth subgingival debridement using a piezoceramic ultrasonic instrument (EMS Piezon Master 400 with A and P perio tips, water coolant and power setting to 85%; EMS).

Q-SRP – control

The patients in the SRP group were subjected to quadrant Scaling and Root Planing at four sessions with an interval of 1 week. An assortment of manual periodontal Gracey curettes was used (LM-dental number 7/8, 11/12, 13/14).

For both treatment protocols, local analgesia was used if requested by the patient. The same expert periodontist who was trained with regard to the various procedures included before the start of the study, carried out the treatment.

All patients received oral hygiene instructions immediately prior the starting of the 1-h session of FMUD in the test group and immediately prior the starting of the first session in the control

group. Therefore patients underwent to monthly plaque control sessions and oral hygiene reinforcement. Patients and/or caregivers were instructed to use chlorhexidine toothpaste twice a day after non-surgical periodontal therapy for 6 months.

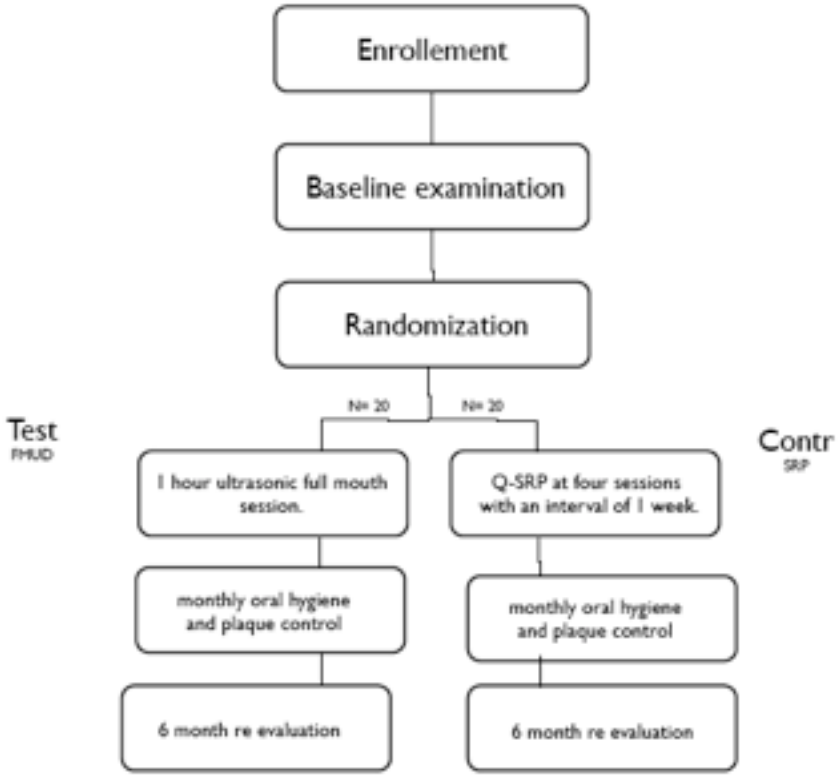

Fig 1. Flow chart of the study design

Statistycal analysis

Descriptive statistics were expressed as mean (SD). Student's t-test was used to evaluate differences between baseline and 6 months follow-up and between groups regarding PD, CAL, REC, PI and BoP. ANOVA for repeated measurements was used to test interaction between treatment and time.
Statistical analysis was performed with Stata (Stata , version 13.0; Statacorp LP, College Station, TX, USA).
In all tests a significance level of 0.05 was chosen.

The descriptive statistics for the clinical parameters measured at baseline and 6 months after therapy for both groups are shown in Table 1

Results

PPD: significant ($p < 0.0001$) decreases were observed in both groups at 6 months compared to the baseline measurements,while no between groups significant differences were found and no interaction effect between time and treatments (Fig 2 and Fig 2a)

REC: significant ($p < 0.0001$) increases were observed in both groups at 6 months compared to the baseline measurements,while no between groups significant differences were found and no interaction effect between time and treatments (Fig 3 and Fig 3a)

CAL: significant ($p < 0.0001$) decreases were observed in both groups at 6 months compared to the baseline measurements,while no between groups significant differences were found and no interaction effect between time and treatments (Fig 4 and Fig 4a)

PI: significant (p value < 0.0001) effect for time and for treatment (p value $=0.0264$)

(or group) and no interaction effect between time and treatments (Fig 5 and Fig 5a)

BoP: significant (p value < 0.0001) effect for time and for treatment (p value =0.0264) (or group) and no interaction effect between time and treatments (Fig 6 and Fig 6a)

Treatment discomfort

None of the patients experienced acute problems (e.g. periodontal abscesses) during the study period. In the test group the mean number of anesthetic's cartridges used during the FMUD session was 1,2 while in the control group was 4,5.

	TEST	CONTROL
PPD		
baseline	6± 0,45	5,98± 0,57
6 months	4,16± 0,66	4,36±0,72
REC		
baseline	1,33± 0,55	1,18± 0,46
6 months	1,92± 0,41	1,75± 0,38
CAL		
baseline	7,34± 0,69	7,16± 0,57
6 months	6,11± 0,57	6,1± 0,67
PI		
baseline	84,55± 10,22	86,1± 9,37
6 months	28,85± 8,88	28,75± 8,64
BoP		
baseline	82,75± 10,11	85,2± 8,33
6 months	23,05± 8,27	29,3± 8,46

Table 1: Descriptive statistics for the clinical parameters measured at baseline and 6 months after therapy

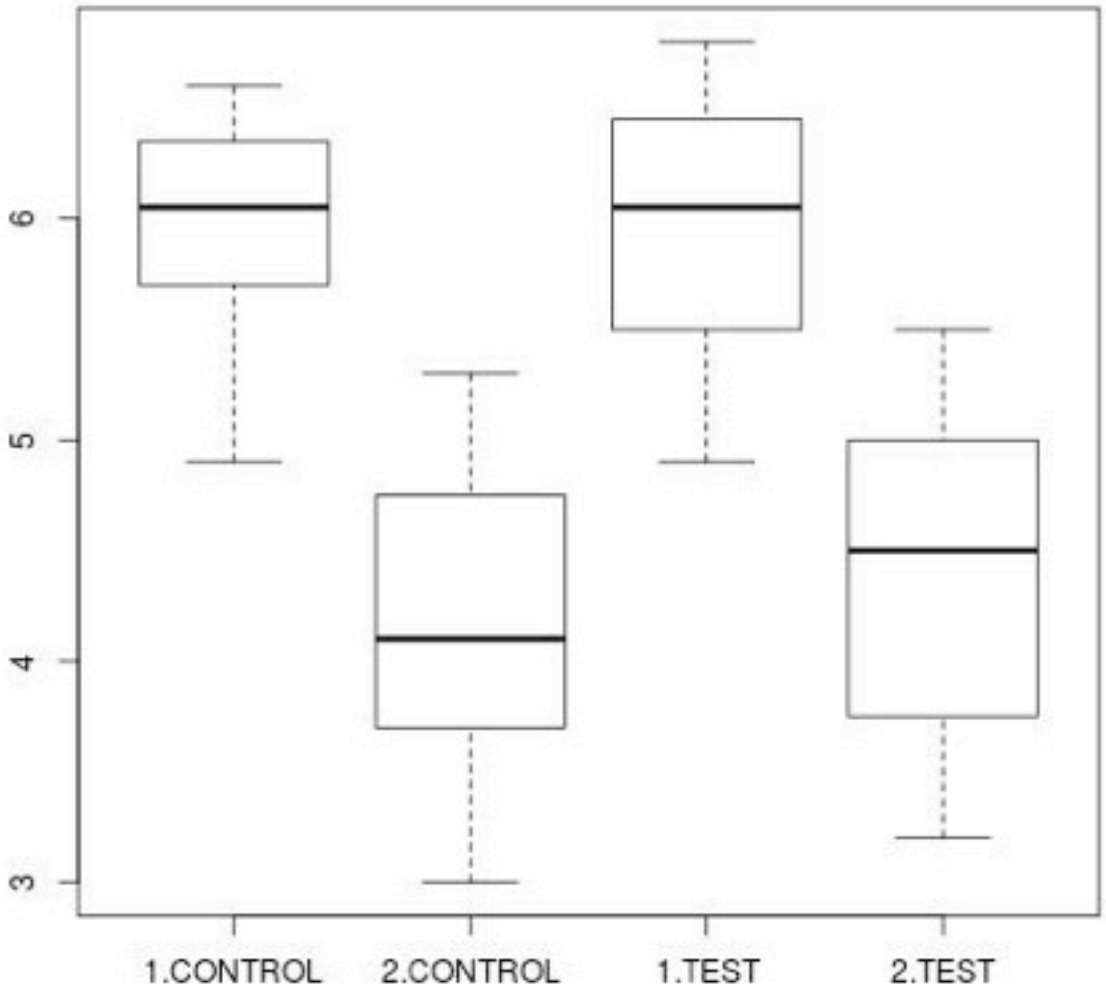

Fig 2: Box plots of PPD measurements for time and group

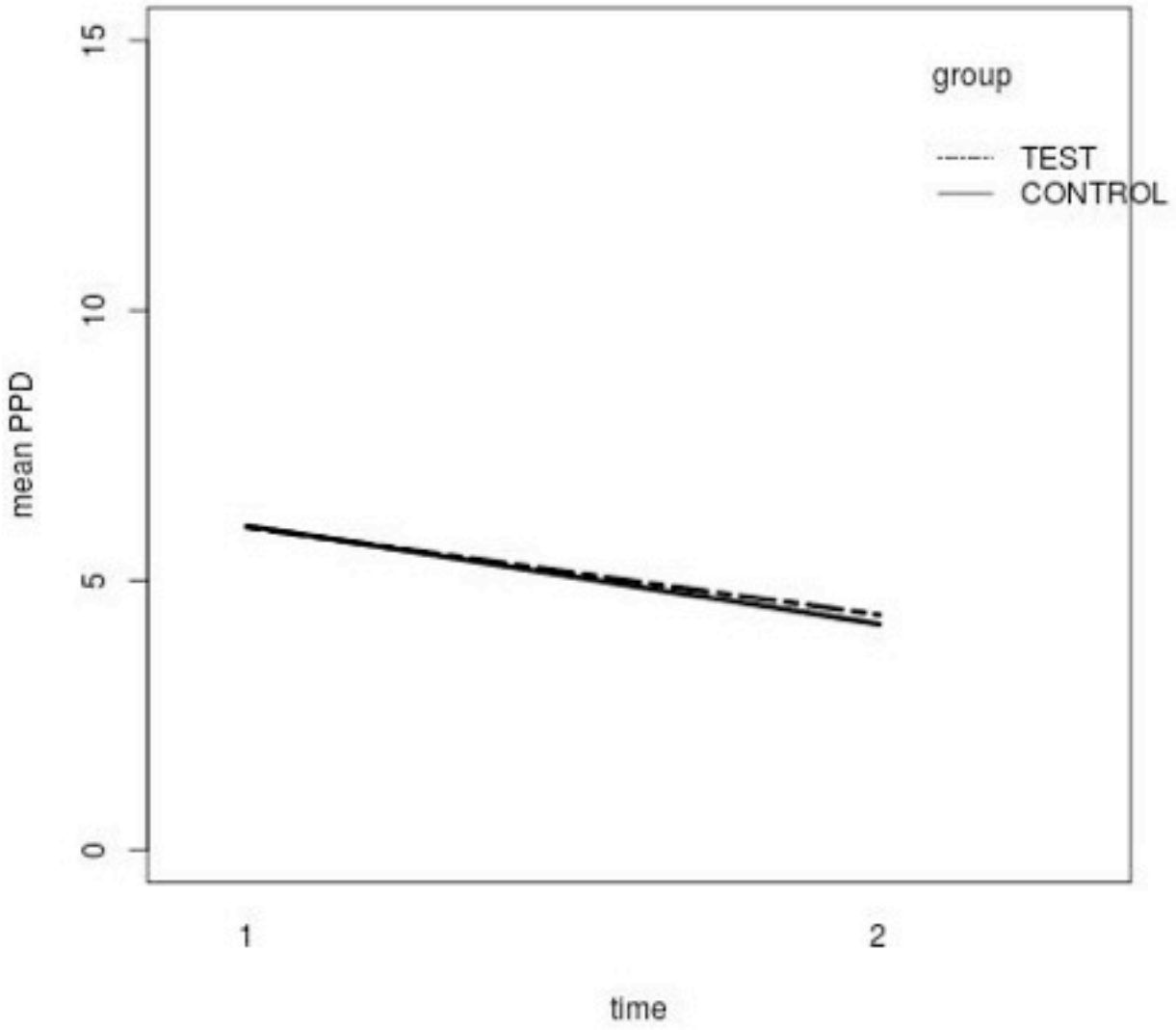

Fig 2a : interaction plots on the PPD measurements means over time

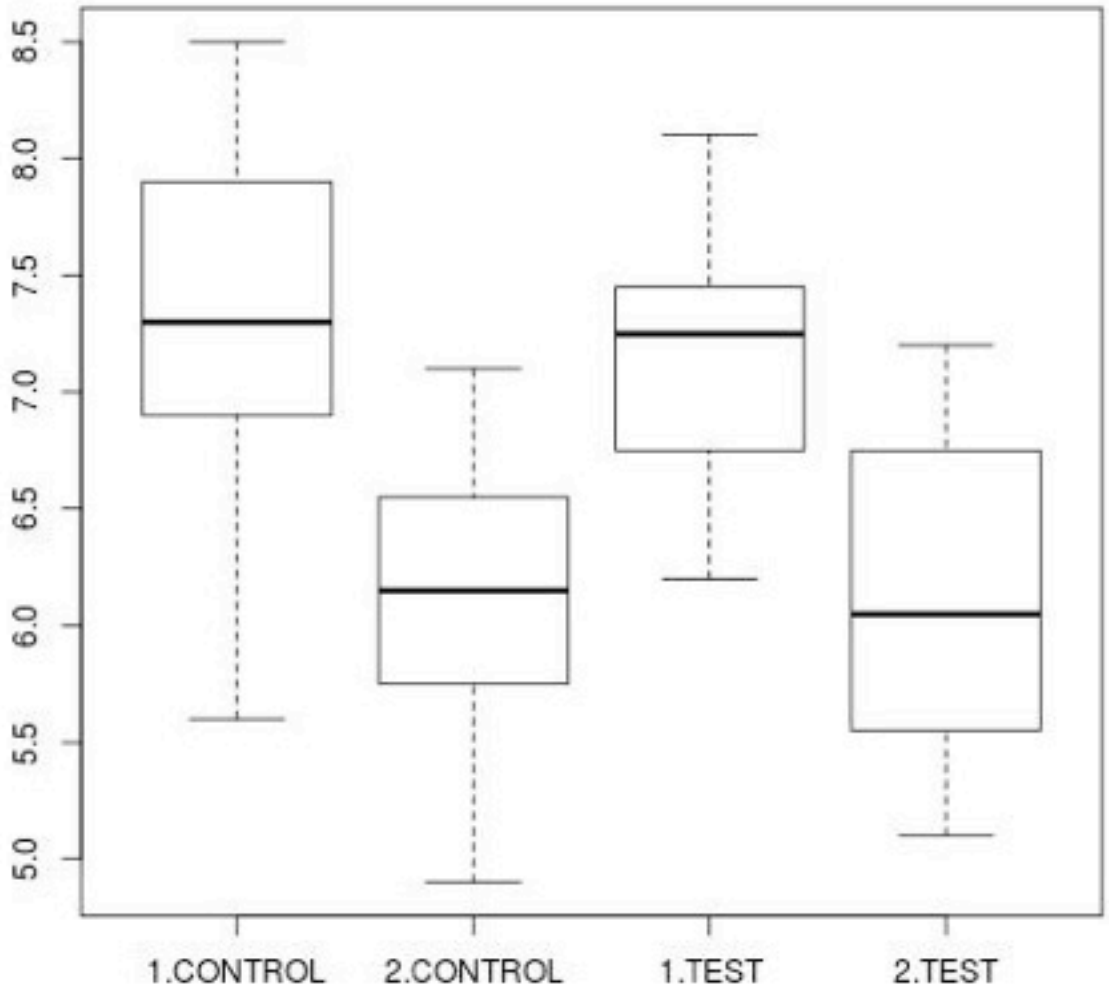

Fig 3: Box plots of REC measurements for time and group

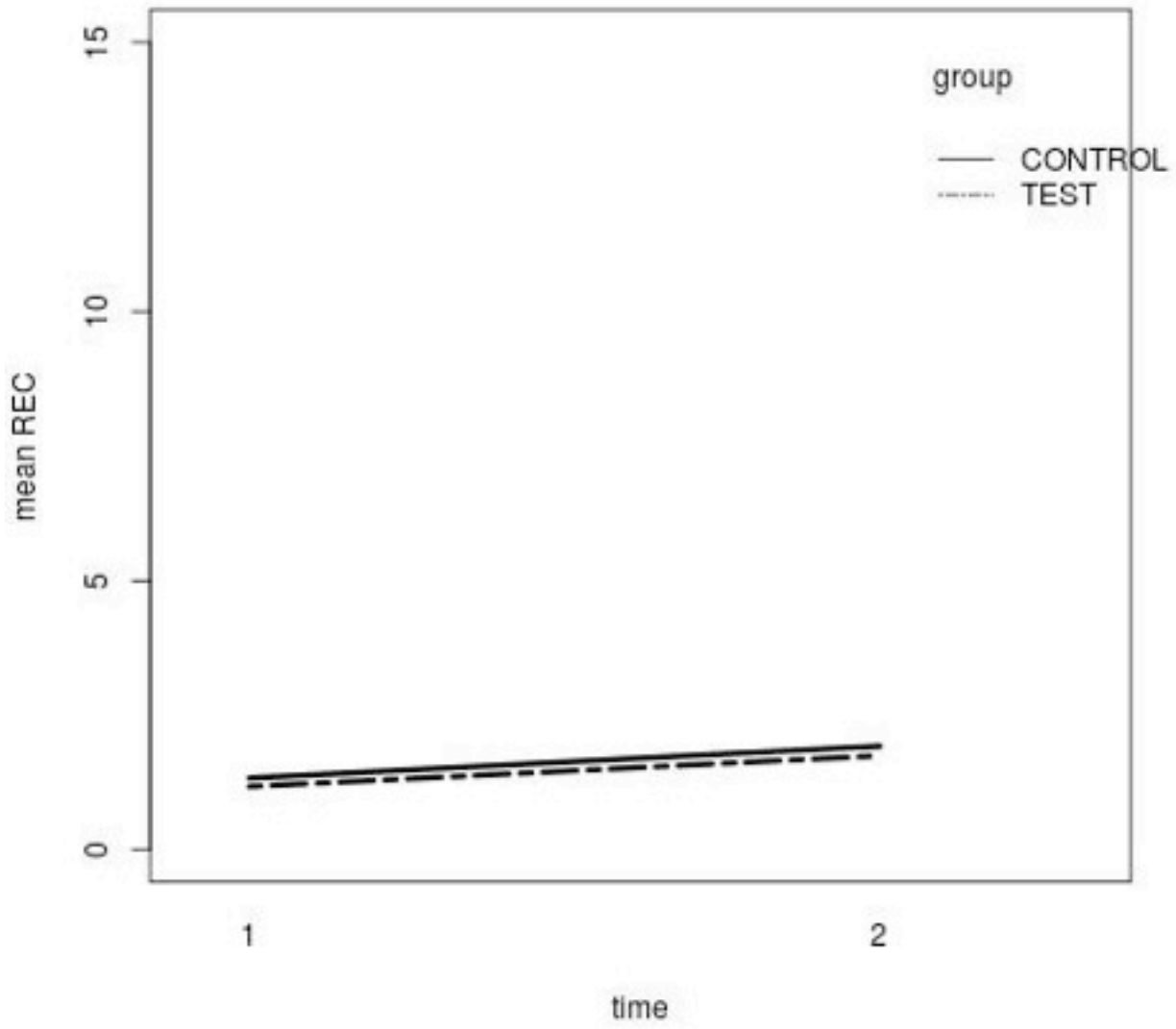

Fig 3 a: interaction plots on the REC measurements means over time

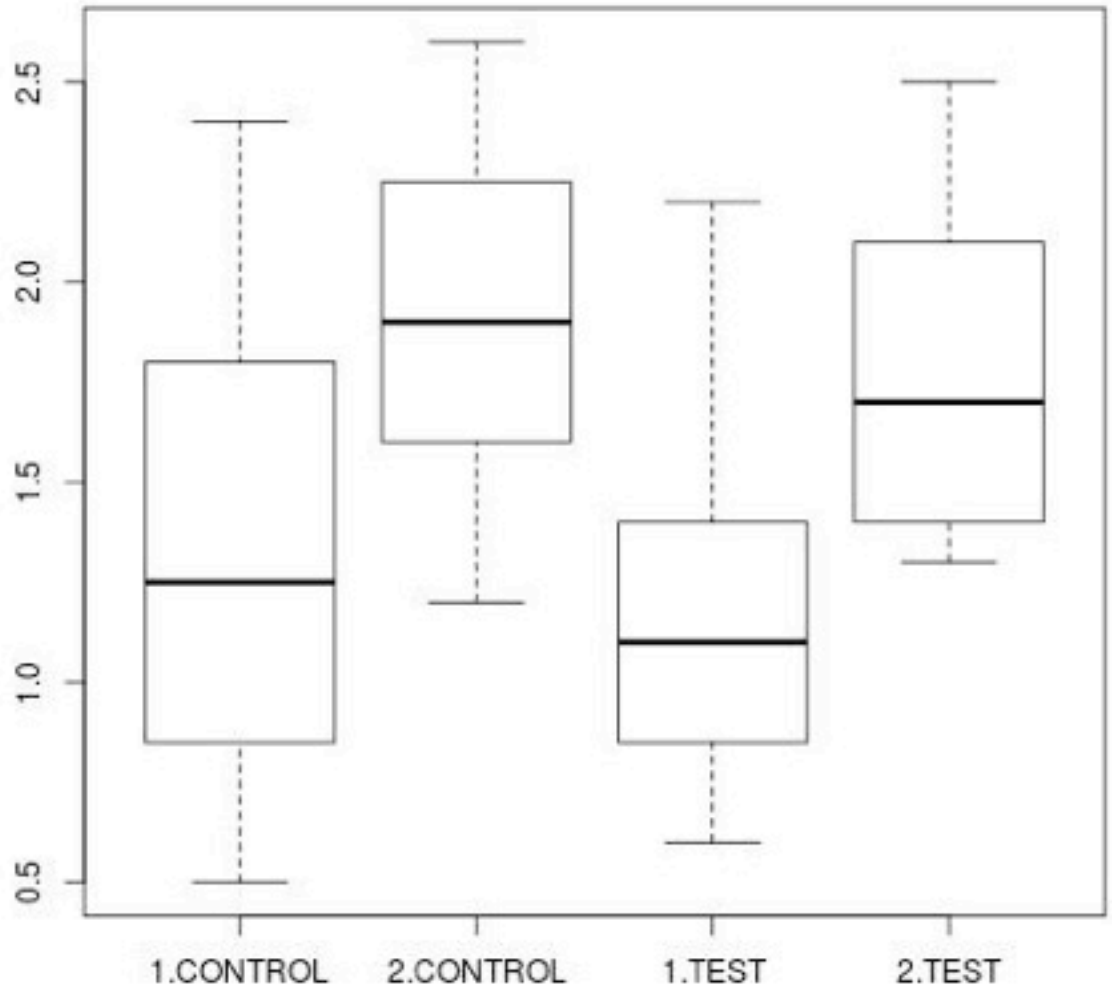

Fig 4: Box plots of CAL measurements for time and group

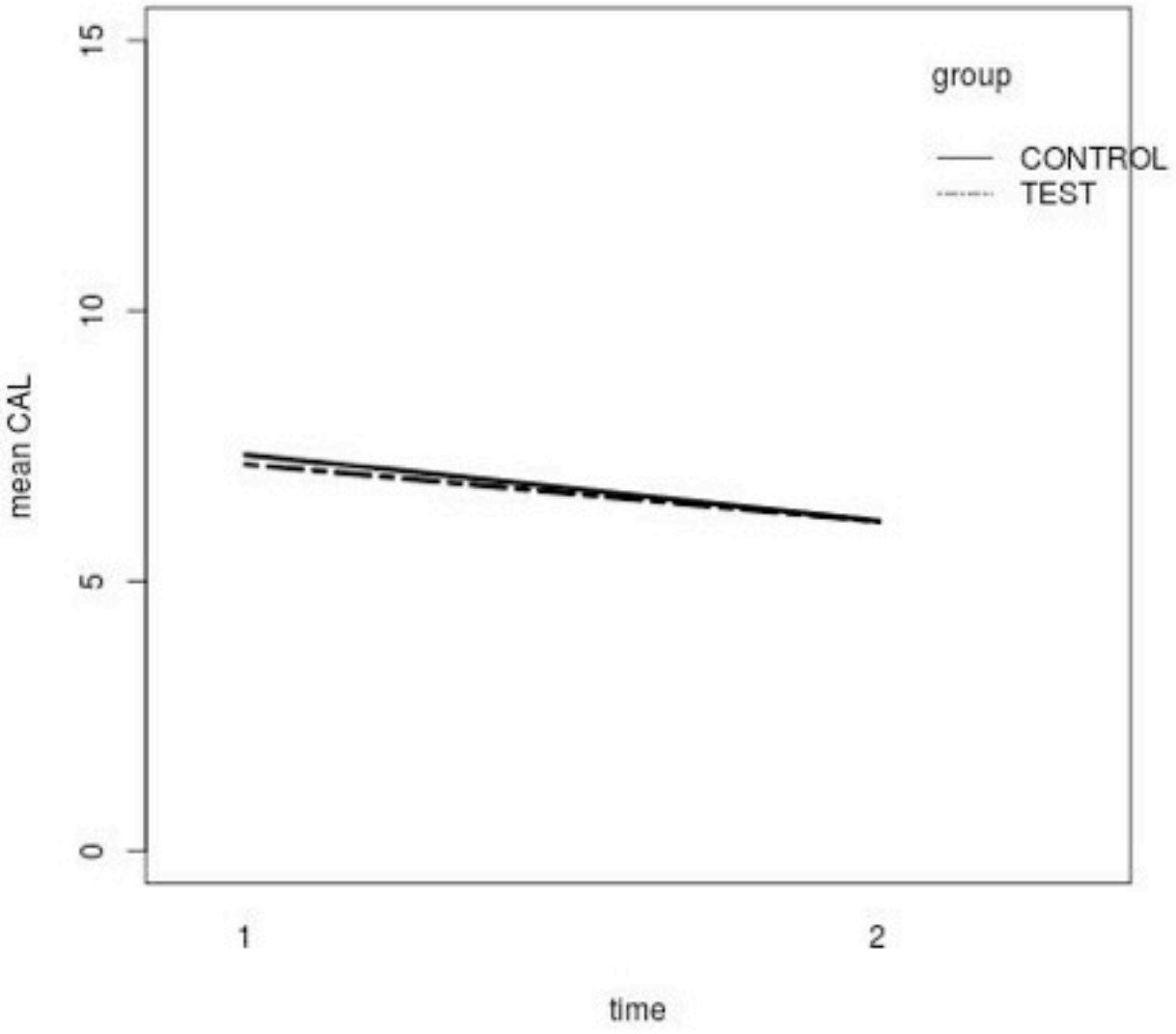

Fig 4a: Interaction plots on the CAL measurements means over time

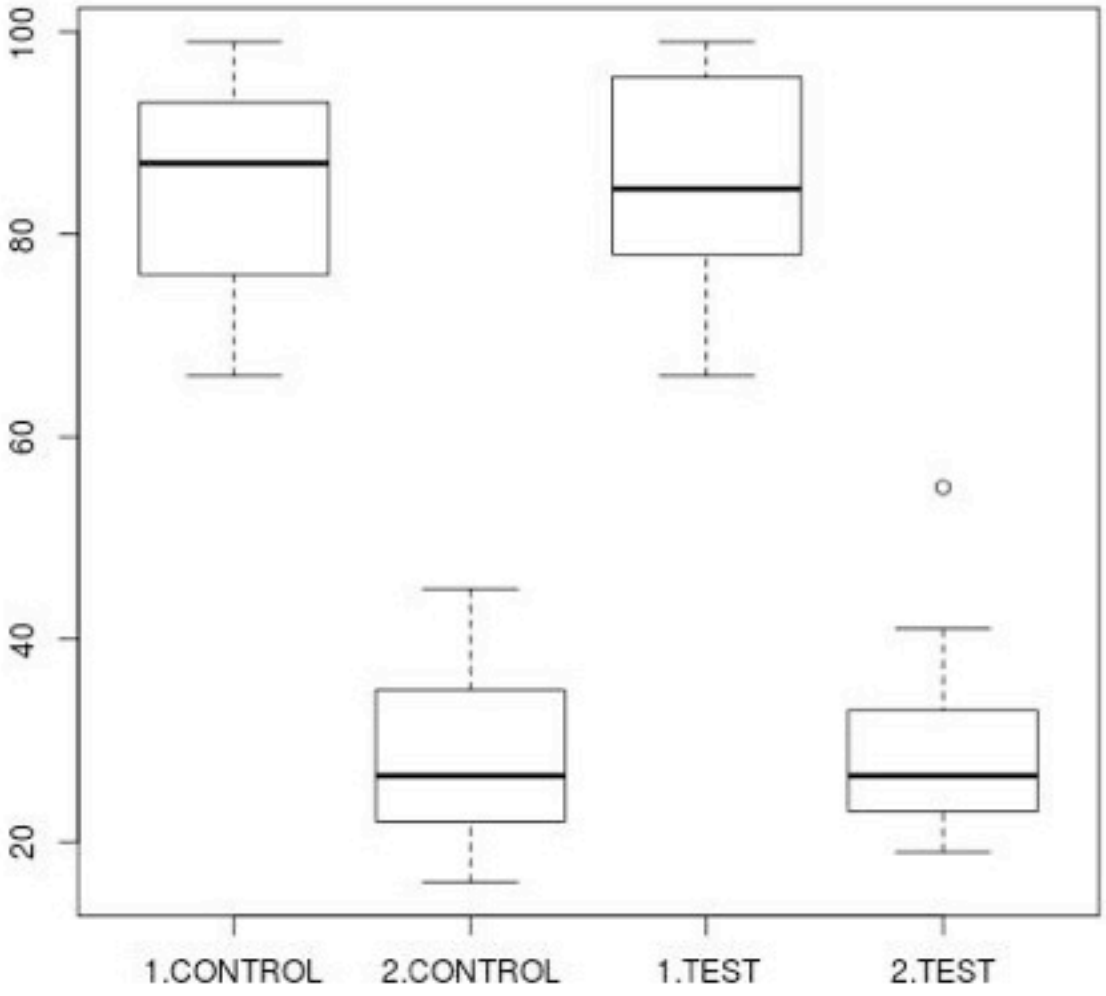

Fig 5: Box plots of PI measurements for time and group

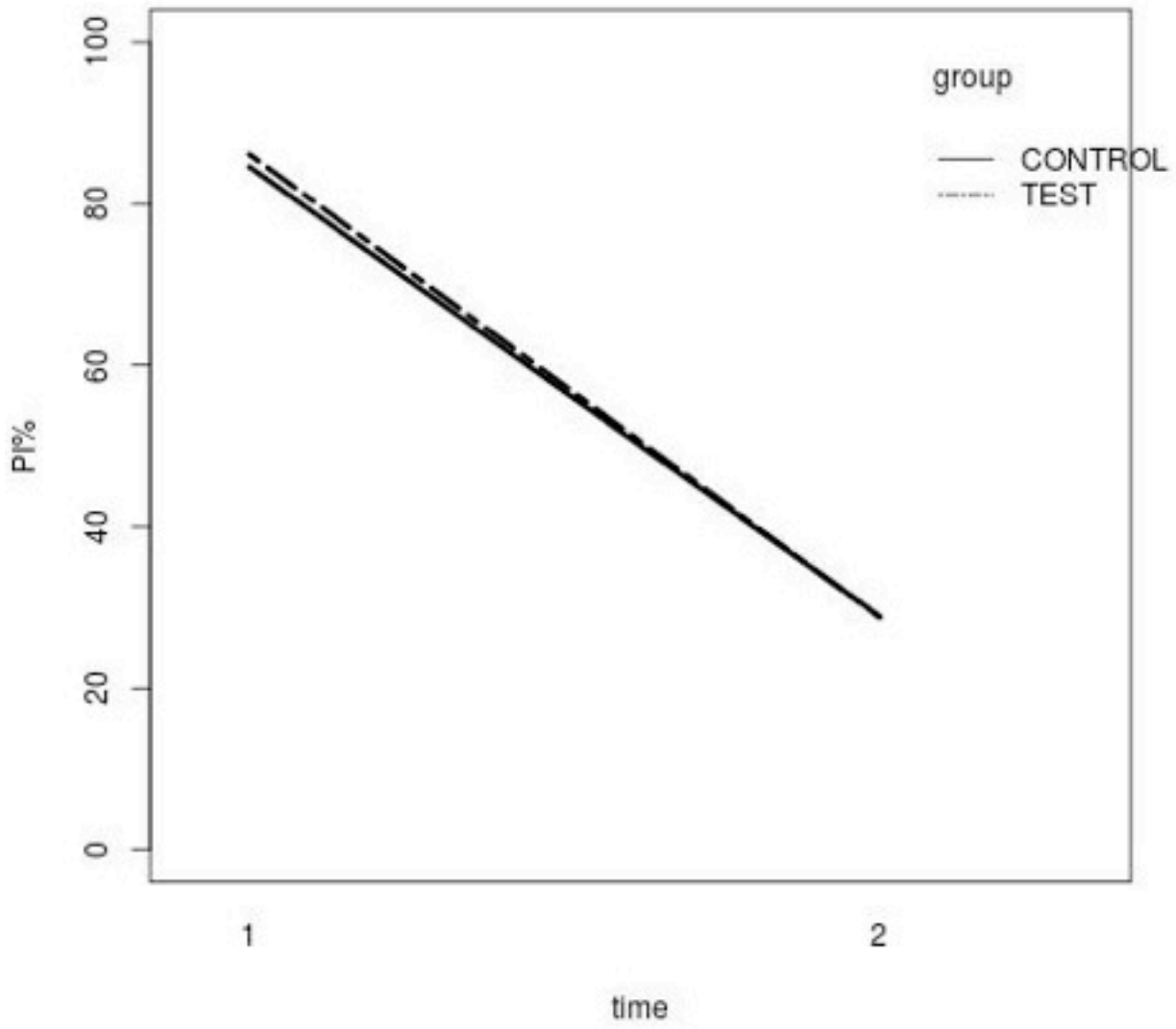

Fig 5a: Interaction plots on the PI measurements means over time

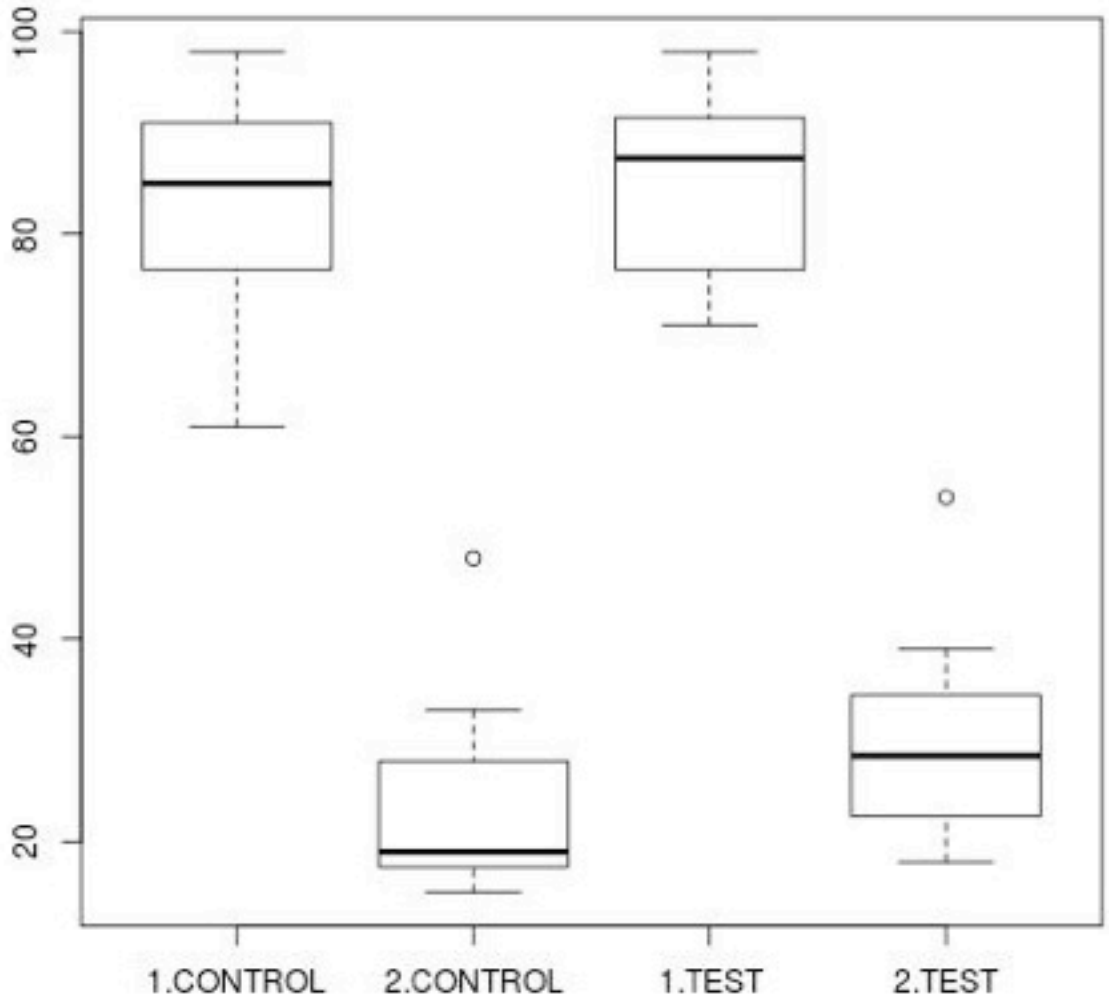

Fig 6: Box plots of BoP measurements for time and group

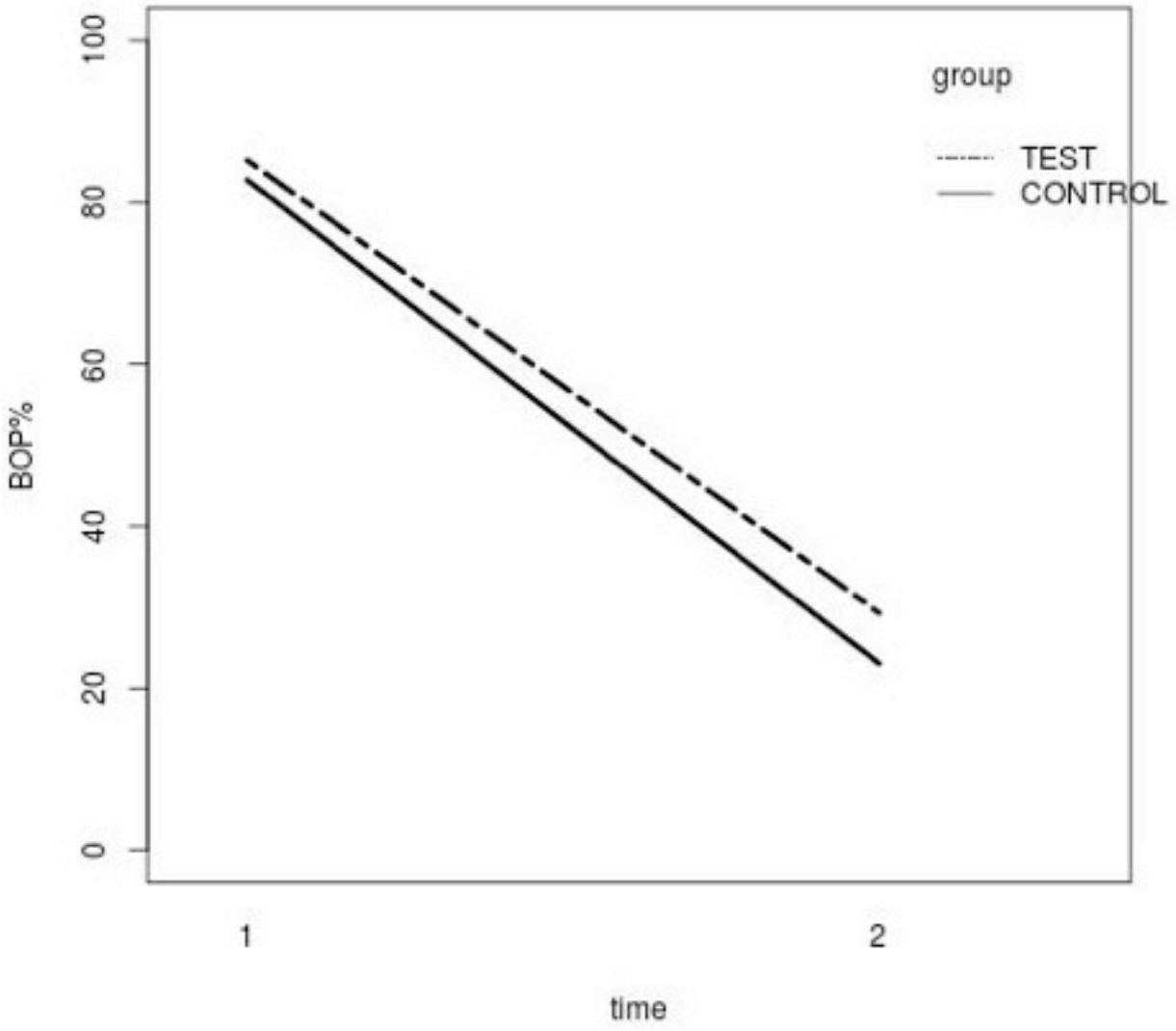

Fig 6a: Interaction plots on the BoP measurements means over time

Discussion

The present study demonstrated the efficacy of a single session of full-mouth ultrasonic debridement (Fm-UD) as an initial periodontal treatment in patient with DS and moderate-advanced periodontitis. The efficacy was demonstrated using for outcome variables the reduction in bleeding on probing and in probing pocket depth which represent the clinical signs of the resolution of the inflammation. In the present study, the full-mouth mean percentage of sites with BOP was reduced from 82 to 23% in the test group and from 85 to 29% in the control group over the 6-months observation period, which is a result similar to the one obtainable in periodontal patients without down syndrome.The mean PPD values at 6 month were 4.16 mm in the test group and 4.36 mm in the control group.

The single session of Fm-UD has already been demonstrated (by Wennstrom et al) to be effective in the infection control in patients with chronic periodontitis and was able to provide clinical improvements that were not significantly different from those observed in a control group treated by Q-SRP. The results of our study performed on DS patients are fully in agreement with those of Wennstrom et al.

However, an important difference in the two studies is detectable. In the present trial in both groups at baseline the percentage of PI was very high in both treatment group:84% in the test group and 86% in the control one.

In the paper by Wennstrom et al performed on patients without disabilities with the same periodontal parameters for inclusion criteria, the baseline PS was in mean 22% in the control group and 23% in the test group. This significant difference could be related to the fact that in the present study patients and/or caregivers were instructed and motivated for oral hygiene procedure during the first treatment session after the baseline measurements collection while patients in the other study were motivated before the treatment sessions and the PS was recorded 3 weeks after the new oral hygiene instruction. The interesting findings of the present study was that after oral hygiene instruction in both study group patients were able to significantly decrease PI and to reach and maintain for 6 months an acceptable level of plaque score: 28% in both groups. This value is somewhat higher than the ideal plaque score we would like to obtain in

periodontal patients which has been settled at a level < 25%. However in this kind of patients with mental and manual disability represents an optimal result which is in agreement with a previous prospective clinical study (Cheng et al.) on patients with DS evaluated at 12 months, that showed a mean percentage of sites with plaque decreasing from 84.1% to 23.6%, and the mean percentage of sites with BOP decreasing from 82.1% to 29.6%.

In the present study patients in both treatment groups were instructed to use twice a day a chlorexidine toothpaste and were monthly recall. This very stringent recall program seems to be the key to success in these patients with poor collaboratives capabilities and these finding is in agreement with a recent case series .Cheng et al 2008 demonstrated that appropriate modifications to routine non-surgical periodontal therapy, with the twice-daily use of chlorhexidine and a monthly plaque control–focused recall schedule, could significantly improve patients' periodontal conditions to levels comparable to those achieved with the non-surgical treatment of periodontitis in adults who did not have DS.

In literature very few randomized controlled clinical trial regarding periodontal treatment in DS patients are present. In a split-mouth design study in 14 DS patients, Zaldivar- Chiapa et al. reported at 1 year no significant differences between surgical and non-surgical periodontal treatment approaches. Conversely, another study (Sakellari et al.), performed in only five subjects treated by non-surgical periodontal therapy showed insignificant treatment responses.

In this perspective a rapid treatment, which does not require long permanence to the chair, slightly painful and invasive, is certainly more indicated. The Fm-UD showed good clinical results in terms of infection reduction and associated with a stringent recall program and with the adjunctive use of chlorexidine could represent an optimal treatment choice in patient with DS and periodontal disease (Quyrinen et al). Moreover this approach has proved to be easily applicable in this type of patients.Indeed, the use of ultrasonic instrument instead of sharp manual curettes is definitely more appropriate because if the patient is not fully collaborative during treatment sessions with manual instrument there is a risk of causing injury.

This approach was able to reduce burden for both patient and family as it requires a single session and a short chair-time with respect to the traditional 4 quadrant therapy.

Furthermore the Fm-UD has proven to be a less invasive technique. The number of anesthetic cartridges used in the test group was significant lower than the control group which means that patient experience less pain with the proposed technique.

Conclusion

No statistically significant differences in terms of PPD reduction and BoP were observed between the proposed techniques and in both group patients obtained a significant improvement of periodontal health status. The Fm-UD from a patient's perspective showed the best results limiting the chair-time and the discomfort.
Further studies with a larger sample size are advocated in order to confirm present data.
In future this approach could be a viable therapeutic option for the treatment of periodontal disease in patient with poor compliance.

References

1)Wennstrom JL, Tomasi C, Bertelle A, Dellasega E. Full-mouth ultrasonic debridement versus quadrant scaling and root planing as an initial approach in the treatment of chronic periodontitis. J Clin Periodontol 2005; 32: 851–859.

2) Ronald H.W. Cheng, W. Keung Leung, and Esmonde F. Corbet
Non-Surgical Periodontal Therapy With Adjunctive Chlorhexidine Use in Adults With Down Syndrome: A Prospective Case Series J Periodonto 2008 vol 2; 78:379-385

3)Yoshihara T, Morinushi T, Kinjyo S, Yamasaki Y. Effect of periodic preventive care on the progression of periodontal disease in young adults with Down's syndrome.
J Clin Periodontol 2005;32:556-560.

4) Zaldivar-Chiapa RM, Arce-Mendoza AY, De La Rosa- Ramirez M, Caffesse RG, Solis-Soto JM. Evaluation of surgical and non-surgical periodontal therapies, and immunological status, of young Down's syndrome patients. J Periodontol 2005;76:1061-1065.

5)Tomasi C, Bertelle A, Dellasega E, Wennstrom JL. Full-mouth ultrasonic debridement and risk of disease recurrence: a 1-year follow-up. J Clin Periodontol 2006; 33:
626–631.

6)Sakellari D.,Arapostathis KN, Konstantinidis A.Periodontal conditions and subgingival microflora in Down syndrome patients. A case-control study. J Clin Periodontol 2005 Jun;32(6): 684-90.

7)Quirynen, M., Mongardini, C., de Soete, M., Pauwels, M., Coucke, W., van Eldere, J. & van Steenberghe, D. (2000) The role of chlorhexidine in the one-stage full-mouth disinfection treatment of patients with advanced adult periodontitis. Long-term clinical and microbiological observations. Journal of Clinical Periodontology 27, 578–589.