ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at: www.ijdsir.com

Volume – 4, Issue – 1, February - 2021, Page No. : 113 - 119

Down syndrome: An Overview

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Citation of this Article: Dr Sanket Kunte, Dr Swarali Shah, Dr Amol Kamble,Dr Shweta Chaudhary,Dr Alok Patel, Dr Rohan Shah,"Down Syndrome: An Overview", IJDSIR- February - 2021, Vol. – 4, Issue - 1, P. No. 113 – 119.

Type of Publication: Review Article

Conflicts of Interest: Nil

Abstract

Down syndrome (DS), named after a British doctor John Langdon Down, is an inherited genetic disorder caused due to trisomy at chromosome 21. Physical growth delays, mild-moderate intellectual disability and characteristic facial features are accompanied with varying levels of mental retardation, general retardation of development, chronic inflammatory lesions, and confluence of congenital and acquired defects.

Physical characteristic neonatal sign include small ears, sandal gap between toes, small internipple distance, brushfield spots, nuchal skin fold, brachycephaly, hypotonia, flat face, upward slant of the eye split, "simian fold" etc. Most evident dental features include the congenital absence lower central incisors, microdontia, retarded root formation, enamel hypoplasia. Caries incidence is low whereas periodontal disease is widely present along with Acute Necrotizing Ulcerative Gingivitis, aphthous ulcers and oral candidiasis.

With the third 21st chromosome existing in every cell, each system is affected in a way. Thus, an early intervention followed by regular check up involving

Multi-disciplinary approach should be performed. With increase in age, anxiety, depression and withdrawal problems might swell up. Hence, as pediatric dental specialists it becomes imperial to study and manage strategies directed towards care of such individuals with the help of behavior management techniques. Maintenance of oral hygiene including prophylaxis, sealant application, and fluoride application should be inculcated in children with Down syndrome right since the beginning. The application of evidence-based assessment followed by intervention strategies might be useful while dealing with array of behavioral challenges set up by such individuals and help in their positive development.

Keywords: Down syndrome, Pediatric Dentistry, Behavior, Interdisciplinary

Introduction

Down syndrome (DS), also referred to as trisomy 21, is a inherited genetic disorder caused by the presence of all or a part of third copy of chromosome 21[1]. In humans, it is one of the most common abnormalities of chromosomes. It is named after John Langdon Down, a British doctor who described the syndrome in 1862 [2] .

The effect of trisomy is chronic and detectable from at least *5* to 6 weeks after conception until after puberty. The distal portion of the long arm of chromosome 21 i.e., (21q) makes up for about 1/3[rd] length of the entire chromosome[3]. In the human, the number of genes that code for different proteins has been established at about *50,000*. Therefore, as many as 750 genes and their products are in a triple dose in each cell of individuals so affected; as many as several hundred loci potentially exist on the putative pathogenetic segment[4].

DS is usually associated with physical growth delays, intellectual disability which is mild-moderate, and characteristic facial features. Additionally, general retardation of development, chronic inflammatory lesions, and the confluence in one individual of many congenital and acquired defects can be characterized. The mental deficiency in DS has a wide range of variability in every single physical and developmental characteristic of mongoloids as well as the sum total of such characteristics in each individual case[4,5].

The parents of the affected individual are typically genetically normal[6]. Hence the probability of producing such a chromosomally challenged offspring increases from less than 0.1% in 20-year-old mothers to 3% in those of age 45[7].

DS can be identified during pregnancy by prenatal screening followed by diagnostic testing or after birth by direct observation and genetic testing. Regular screening is recommended throughout the person's life as there is no cure for the condition[8]. However, proper care and education have been shown to improve quality of life.

History

The artifacts dated 2500 years ago[9] marks the earliest evidence for the existence of the syndrome. Seguin published a treaty on “the education of idiots” in 1846 which gives an extended description of Trisomy 21. Twenty years later, an English physician, John Langdon Down published an essay describing the phenotype of children with common features distinct from “Mongoloids”[10]. World Health Organization (WHO), in 1965 dropped the term mongolism; later, the National Institute of Health, USA, suggested the term Down syndrome to replace all the other names describing such a phenotype in 1975[11].

Incidences

The incidence of Down syndrome is approximately 1 in 600–1000 live births[12]. The frequency was 1 per 1150, according to a survey by Verma et al, 2000 which involved 94,910 newborns from Mumbai, Delhi and Baroda. The observations were opposite to that of

incidences in tribal population of the village in India. (0.81–1.2/1000 live births).

Globally, as of 2010, Down syndrome had occured in about 1 per 1000 births[15] and resulted in about 17,000 deaths[16]. Accoding to a survey in 2015, Down syndrome was present in 5.4 million individuals globally. It resulted in 27,000 deaths, down from 43,000 deaths in 1990[17].

The probable cause for the increase in DS is related to increased maternal age. A women over 35 was observed to be five times more likely than younger women to have children with DS[18]. It also varies according to several socio-cultural variables. For instance, in countries like Ireland and UAE, where abortion is illegal the prevalence is also higher. Conversely, in France, DS prevalence is low, and this is probably due to a high percentage of DS pregnancy terminations[18,19].

Genetic Potrait

Trisomy 21 is stated to be a result of Genomic Aneuploidy wherein an abnormal number of genomic copies is the reason for causing genetic disorders. A total 225 genes were estimated when initial sequence of 21q was published[20] and DS complex phenotype is believed to be a result of dosage imbalance of genes located on human chromosome 21(HSA 21). After Southern blot dosage analysis of 32 markers unique to human chromosome 21, the shift of contribution of genes outside the D21S55 region to the DS phenotypes was observed. These phenotypes included microcephaly, hypotonia, short stature, abnormal dermatoglyphics along with mental retardation.

Clinical Features

Amongst the physical neonatal signs, Small ears, Wide space in between the 1st and 2nd toe (“Sandal gap”), Small internipple distance, Brushfield spots, Nuchal skin fold are considered most reliable and discriminative; Brachycephaly, Hypotonia, Flat face, Upward slant of the eye split, Transverse line in the palm of the hand (“Simian fold”) are reliable and discriminative; Epicanthus fold is age dependent; and Low, flat nose bridge and Small mouth are difficult to differentiate features[21,22].

People with DS may have some or all of these physical characteristics. The changes in anatomy of airway lead to Obstructive Sleep Apnea whereas; short fingers, hip dislocation, instability of atlantoaxial joints, slower growth in height, increased risk of obesity are certain other features.

Other than the constant feature of mental retardation, DS individuals also commonly exhibit Congenital heart diseases, increased risk for specific leukemias, developmental abnormalities, early onset Alzheimer’s disease, immunological deficiencies which leads to infectious diseases, Vision disorders, Hearing problems, Intestinal problems such as blocked small bowel or esophagus, Celiac diseases, Thyroid dysfunctions, Skeletal problems etc.

Dental Features

Dental anomalies are believed to be occurring in around 44% sufferers of DS in a study done by Oliveira et al[23]. Most evident features include the congenital absence of teeth most commonly the lower central incisors, microdontia, oligodontia, retarded root formation, enamel hypoplasia[24]. Structural abnormalities include fusion, taurodontism, peg-shaped teeth, fusion and germination[25].

When caries risk of DS individuals is concerned, the incidence is observed to be low[26]. Reasons could be increase in the pH of the saliva and the level of bicarbonate present, the reduction in the number of Streptococcus mutans and even the morphology of the teeth wherein there are minimal pit and fissures owing to the habit of bruxism which is commonly present.

On the contrary, periodontal disease is present in almost all individuals afflicted by the Syndrome, which is believed to be due to the defective immune system rather than poor dental hygiene[27]. Pilcher reported the incidence of periodontal disease between 90% and 96% in his study. There is also a high prevalence of acute necrotizing ulcerative gingivitis (ANUG) as well as aphthous ulcers and oral candidiasis.

A common finding of mid-face deformity also gives an appearance of relative prognathism. Patients usually present with Class III malocclusion. Oliveria et al [23] observed that there is also a high prevalence of anterior open bite (21%), anterior crossbite (33%) and posterior crossbite (31%), in 100 individuals with Down syndrome. There is often a greater tendency of finger sucking, contributing majorly to the anterior open bite cases. There is also cracking lips (angular cheilitis), aphthous ulcers and infectious conditions like candidiasis seen.

Screening And Diagnosis

DS amongst any other chromosomal disease is the most common cause of mental retardation among children. Hence, screening is an important part of routine prenatal care. The most common screening method contains the measurement of a combination of factors: advanced maternal age, multiple second trimester serum markers, second trimester ultrasonography, ultrasound, blood test, Nuchal Translucency (NT) scan[28,29].

Besides these screening methods, rapid molecular assays like FISH(fluorescent in situ hybridization), QF-PCR (quantitative fluorescence PCR), and MLPA(multiplex probe ligation assay), Paralogous Sequence Quantification (PSQ) are also used for prenatal diagnosis[20].

Interdisciplinary Approach and Dental Management

With the third 21st chromosome existing in every cell, it's not surprising that each system within the body is affected in a way. Timely surgical corrections of defects can prevent life-threatening events or complications with growing age. Thus, a DS child should have regular check up from various consultants. Clinical geneticist, Cardiologist, Pediatric pneumonologist, Ophthalmologist, Neurologist/Neurosurgeon, Orthopedic specialist, Child psychiatrist, Physical and occupational therapist, Speech-language pathologist, Audiologist are amongst the few who need to work hand in hand for management of such individuals.

Most children with DS readily gel up with and share common schools, neighborhood and workplaces. However some need extra care or special attention as the environment is hindered by their challenging behavior. They are, in such cases, referred to as “stubborn”, or “obstinate”. Higher rate of attention problems, social withdrawal, noncompliance, high rates of self talk are few of the behavioral observations in such children. With increase in age, anxiety, depression and withdrawal problems might swell up. Hence, as pediatric dental specialists it becomes imperial to study and manage strategies directed towards care of such individuals.

There occur various events which might aggravate the incidences of a stressful or challenging behavior. Parents and caregivers should make a note of it in schools, at home, at public spaces etc. This in addition with the various behavior management techniques should be considered and taken care of while dealing with such an individual. Efforts should be made to engage the child into conversations which might induce them to develop their own thinking. Those with limited conversation skills should be intervened using graphic representation of activities to be performed. For instance, in a dental setting, the child can be sensitized towards a particular treatment using Tell-Show-Do technique, observing his responses, understanding their way of expression while questioning or responding to certain stimulus.

As far as clinical management is concerned, though the incidence of dental caries is low, it does not guarantee caries free oral environment throughout the life. Hence, maintenance of oral hygiene should be inculcated in children with DS should be treated right since younger age.

Dental health care involves maintenance of good oral hygiene, bi-annual prophylaxis treatment, systemic and topical fluoride application, occlusal sealants. When periodontal health is considered, oral prophylaxis may not suffice, and early aggressive treatment in the form of scaling and root planing might be required. Patients may also benefit from the use of chlorhexidine mouth rinse and possibly systemic antibiotic therapy[26]. Newer mechanical tooth brushing and flossing devices might aid individuals with intellectual impairement and dexterity issues.

While performing such modalities, the training must also be aimed at teaching the child to omit certain unacceptable behavior or tantrum and an alternative approach of response should be systematically inculcated. Apart from all the non-pharmacological behavior modification techniques, certain individuals might also possess the need for pharmacological management based on their co-operative ability[30].

Areas of aid like dental medicine, prosthodontics, orthodontics and reconstructive oral surgery shouldn't be ruled out just because the patient has DS. Finally, the parents and caregivers should be actively participating and encourage the individuals. This will also help the clinician while performing more aggressive treatment modalities and maintaining a good rapport with the patient.

Conclusion

Down syndrome is a birth defect with huge medical and social costs. Due to advances over decades, the health and life expectancy of these individuals has improved resulting in more people living into adulthood. Most of the positive improvements in their quality of life are found to be a result of parental support and behavior modification techniques. Hence, the application of evidence-based assessment followed by intervention strategies might be useful while dealing with array of behavioral challenges set up by such individuals.

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