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Genetics in Paediatric Dentistry - Review Article

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Abstract

Genetics plays a very important role in normal craniofacial development, abnormal dental anomalies, and different dental diseases such as dental caries, periodontitis, and dental malocclusion. Even it has a great role in different oral cancers also. Very little importance is given for genetic screening and diagnosis of dental diseases. This article attempts to gather insight about different dental diseases and their genetic basis, the need for genetic screening and testing to avoid future problems.

Keywords: Dental caries; Genetics; Paediatric dentistry

Introduction

Genetics is a branch which deals with science of potentials. It deals with the study of biological information and transfer from cell to cell, from parents to their offspring, and thus from generation to generation. Genetics has revealed that individuals share 99.9% of their DNA sequences and their characteristics. Thus, the remarkable diversity of humans is seen in about 0.1% of our DNA [1]. Genetics is the science of heredity and its variation. It plays an important role in determination of individuality characteristics [2].

The term "genetics" conveys with the two different concepts: genetics deals with the study of inherited characteristics, and genetics deals with the study of cellular processes controlled by DNA. Developmental defects of teeth can occur as the isolated genetic traits, can be associated with a chromosomal abnormality or syndrome, or can be inherited as a complex trait with the genetic and environmental interactions [3]. Numerous hereditary syndromes have been associated with congenitally missing teeth. Often paediatric dentists are the first health care practitioners to document dysmorphic characteristics features in a child. It is important for them to have an knowledge of molecular genetics because the sensitivity and specificity of molecular-based diagnostics have revolutionized about the diseases and disorders [4].

Historical Perspective

Stent (1971) showed the first evidence of inheritance was taught and developed by the Hippocrates in fifth century BC in Greece. Hippocrates ideas can be termed as bricks and mortar theory which states that the hereditary material consists of physical matter. His postulates states that the elements from all part of the body became concentrated in the male semen and then formed into a human in the womb. He also believed in inheritance of acquired characteristics [5]

The advent of protein and DNA

sequencing had launched a new era of phylo genetics. Species could now be compared at the biological molecular level. The information age is essential to the genomics. The electronic analysis, distribution and storage of the genomic data is a hallmark of the science [6].

Fundamentals of Genetics

The genome contains the entire genetic component of a set of chromosomes present within the cell or an organism. Within genome are the genes that represent the smallest physical and functional units of inheritance that resides in specific sites called ―loci‖ or ―locus‖ for a single location site [7]. The term gene was first coined by Wilhelm Johannsen in 1909. The gene was first defined as the unit of genetic information that controls a specific aspect of the phenol type. At a more fundamental level the gene has been defined as the unit of genetic information that specifies the synthesis of single polypeptide [8].

Functions of Genes

Through the replication that results in more units like themselves.

Through transcription and translation process, whereby proteins that function as determiners in metabolism of cell are synthesized.

Genes act by the determining the structure of proteins, which are responsible for directing cell metabolism process through their activity as enzymes [9].

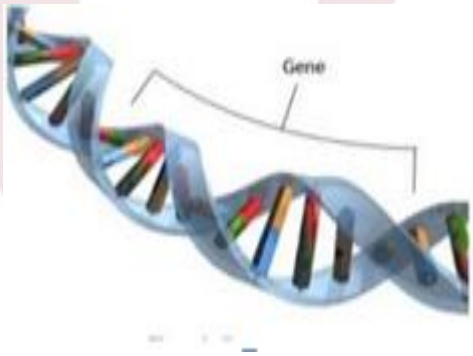

Figure 1: Genes

Genetics and dental caries

Genetics In dental Caries through Twin Studies, dental caries is a disease of the dental hard tissues, characterized initially by the decalcification of tooth. Studies of the etiology of dental caries suggested that both genetic and environmental factors may be concerned with the development of dental caries process. Several major genes have been identified which the condition of defective formation of enamel or dentine leading to development of rampant caries in such teeth [6].

Genes and Saliva

Human saliva is a compound mixture of proteins. Kauffman and Keller estimated that as much as two thirds of parotid salivary proteins belong to a caries process and contributes to the greater monozygotic similarity in dental caries experience are,

Salivary factors and oral flora

Tooth eruption time and sequence,

Tooth morphology,

Arch shape,

Dental spacing [7]

Genetic Modification of Dental Enamel Altering Susceptibility

Amelogenin, is the protein product of the AMELX Xp22.3-p22.1 and AMELY Yp11 genes, is considered to be the critical for normal enamel thickness and structure of tooth8. Amelogenin is likely to be the candidate gene for caries susceptibility in humans and has differential expressions in males versus females [9] Mutations and deletions in amelogenin cause one of the forms of X-linked Amelogenesis imperfecta. Ameloblastin is expressed as, during the differentiation of inner enamel epithelium into ameloblasts, with intense localization in the Tomes processes of secretor ameloblastic cells [10].

Genetics and Chromosomal Disorders

Chromosomal disorders are caused by abnormality in chromosome number or their structure.

Mendelian disorders are caused by abnormality of a single gene.

Non Mendelian disorders are caused by mitochondrial mutations or altered gene expressions resulting from the imprinting. Chromosomal disorders are congenital or acquired [11]. Acquired chromosomal disorders are important in the pathogenesis and evolution of hematologic, solid organ malignancies [12]. Congenital chromosomal disorders occur in the ratio of approximately 1 in 150 live births; they with the exception of X and Y chromosomal disorders occur in pediatric age groups [13].

Trisomy 21 Syndrome Down‘s syndrome, or mongolism, is one of the most common identifiable malformation syndrome. In 1866, Langdon Down published an essay in England in which he described, that a set of children having common features who were distinct from other children with mental retardation that he named ―Mongolian idiocy [14].

Usually, a dentist can place an artificial denture instead of a tooth. Then, after the jaw's development is completed, the implant can be performed. Alternative treatments for replacing the missing teeth in growing individuals should be considered, which may include auto-transplantation [19], resin-bonded bridges [20], and closing the space with an orthodontic appliance [21].

Cytogenetics

Genes that may have input into Down syndrome include: Superoxide Dismutase (SOD1)—over expression may lead to premature aging and decreased function of the immune system; its role in Senile Dementia of the Alzheimer's type or decreased cognition is still speculative [15].

Cherubism

Hereditary fibrous dysplasia of the jaws, familial intraosseous swellings of the jaws, Familial multi-locular cystic disease of the jaws). Cherubism is a hereditary condition that produces firm, painless swellings that occur bilaterally in the jaws, especially over the mandibular angles or regions [16]. The impact of cherubism lesions was on the development and eruption of the primary and permanent dentition varies depending on the time of onset and severity of the extending lesions. The alignment of primary teeth can be disturbed. Disruption of the secondary dentition can include absent teeth (mostly molars), anodontia [17].

Amelogenesis Imperfecta Amelogenesis imperfecta (AI) is a group of inherited defects of enamel formation that show both the clinical and genetic heterogeneity characters. In its mildest form, AI causes discoloration, while in the most severe presentation the enamel is in hypo mineralized condition leading to be abraded from the teeth shortly after their eruption into the mouth. Both the primary and permanent dentitions are affected [18].

Genetics and Periodontal Diseases

Periodontal diseases are a heterogenous group of diseases characterized by different degrees of pathological changes in periodontium. It results in the destruction of the supporting structures and most of the destructive processes involved are host derived factors.

Early Onset Periodontits (Aggressive Periodontitis)

Aggressive periodontitis was previously classified early onset periodontitis. It was included as pre-pubertal, juvenile and rapidly progressive forms of periodontitis. Aggressive periodontitis classified as the localized or generalized [19]. Localized aggressive periodontitis have the interproximal attachment loss on at least two permanent t dentition (first molars and incisors) with attachment loss on no more than two teeth other than first molars and incisors. Generalized aggressive periodontitis patients exhibit generalized interproximal attachment loss features including at least three teeth that are not first molars and incisors [20].

Gingival Enlargement

It is the overgrowth of gingiva identified by an expansion and accumulation of the connective tissue fluid with occasional presence of increased number of cells in it. Gingival enlargement may result from the chronic gingival inflammation. It may occur as drug-related side effect complications in some individuals [21].

Genetic Testing

Genetic screening‖ denotes assays undertaken on a population wide basis to recognise the at-risk individuals. ―Genetic testing‖, designed to provide a definitive diagnosis treatment; these are performed because of positive screening results, family history, ethnicity, physical stigmata, or other multifactorial reasons [22].

Diagnostic testing

Diagnostic testing is done to diagnose or rule out the specific genetic or chromosomal conditions.

Carrier testing

Carrier testing is used to recognise people who carry one copy of Gene mutation characters that, when present in two copies, causes a genetic disorder [23].

Prenatal diagnosis: Used to diagnose changes in a foetus genes or chromosomes before the birth [24].

Genetic Counselling

Modern genetic counselling is a communication process between a healthcare professional trained in genetics and an individual and family affected by inherited diseases. The goals of this process included, spreading the knowledge of medical and dental facts, to understand the contribution of hereditary conditions and its risk factors [25].

Conclusion

Genetic disorders are seeming to be attended with less importance than other diseases in public health problems. In underdeveloped countries, neonatal and natal infant mortality is mostly due to lack of knowledge and ignorance in prevention among public. Therefore, for better understanding of genetic causes of diseases can facilitate early detection in high risk individuals.

References

Sturtevant AH. A history of genetics.

Phil McClean. A History of Genetics and Genomics (2011).

Snustad DP, Simmons MJ. Principles of genetics.5 thedn. Asia (2002).

Cooper GM, Hausman RE. The cell-A molecular approach.5 th edn.ASM press.

1. Gardner EJ, Snustad DP. Principles of genetics.7 thedn. Singapore (1984).
2. Vieira AR. Genetics and Caries – Perspectives. Braz Oral Res. (2012) 26: 7–9.
3. Goldberg S. The dental arches of identical twins. Dental Cosmos. (1937) 72: 869-881.

4. Bordoni N, Dono R, Manfredi C, Allegrotti I. Prevalence of dental caries in twins. J Dent Children (1973) 40:440-443.

5. Mansbridge JN. Heredity and dental caries. J Dent Res. (1959) 38: 337-347.

6. Finn SB, Caldwell RC. Dental caries in twins I. A comparison of caries experience of monozygotic twins, dizygotic twins and unrelated children. Arch Oral Biol. (1963) 8: 571-585.

7. Boraas JC, Messer LB, Till MJ. A genetic contribution to dental caries, occlusion and morphology as demonstrated by twins reared apart. J Dent Res (1988) 67: 1150-1155.

8. Klein H, Palmer CE. Studies of dental caries. V. Familial resemblance in caries experience in siblings, Public Health Rep. (1938) 53: 1353-1364.

9. Klein H. The family and dental disease. IV. Dental disease experience in parents and offsprings, J Am Dent Assoc. (1946) 33:735-743.

10. Li Y, Caufield PW. The fidelity of initial acquisition of mutans streptococci by infants from their mothers .J Dent Res. (1995) 74: 681-685.

11. Goodman HO, Luke JE, Rosen S, Hackel E. Heritability in dental caries, certain oral microflora and salivary components. Am J Hum Genet. (1959) 11: 263-273.

12. Mcdonald RE, Avery DR. Dentistry for the Child and Adolescent.8 TH edn. (2004).

13. Fairpo CG. Total caries experience in monozygotic and like-sexed dizygotic twins of Caucasoid origin aged 5 to 15 years. Arch Oral Biol (1979) 24: 491-494.

14. Gorlin RJ, Cohen MM, Levin LS. Syndromes of the Head and Neck 3 rd Edition. NY: Oxford Univ. Press (1990) pp: 700-704.

15. Korenberg JR et al. Down syndrome phenotypes: The consequences of chromosomal imbalance. ProcNatlAcad Sci. (1994) 91: 4997-5001.

16. Patterson D. The integrated map of human chromosome 21. In Etiology and Pathogenesis of Down Syndrome, Wiley-Liss (1995) pg: 4355.

17. Kalantar MH: Treatment of cherubism with locally aggressive behavior presenting in adulthood: report of four cases and a proposed new grading system. Journal of Oral and Maxillofacial Surgery (1998) 56: 1336-1342.

18. Raposo CE, et al: Two-stage surgical treatment of severe cherubism. Annals of Plastic Surgery (2007) 58: 645-651.

19. Thompson N: Cherubism: familial fibrous dysplasia of the jaws. British Journal of Plastic Surgery (1959) 12: 89-103.

20. Crawford PJ, Aldred MJ. X-linked amelogenesisimperfecta. Presentation of two kindreds and a review of the literature. Oral Surg Oral Med Oral Pathol. (1992) 73: 449-455.

21. Li W, Gao C, Yan Y, DenBesten P. X-linked amelogenesisimperfecta may result from decreased formation of tyrosine rich amelogenin peptide (TRAP). Arch Oral Biol. (2003) 48:177-183.