

## Genetics: Current State, Advances and Challenges in Dentistry

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### Description

Motivation towards the detailed study of oral diseases and its organizational and institutional conditions has prompted research creativity in science. Advancement of dentistry has developed as the unique resource to provide oral health systemic approach. The beginning of dentistry has focused on rehabilitation and restoration of the lost dental structures and today the advancement is focused on the esthetics, restoration and genomes.

The breakthrough advances in dentistry included nanodentistry, tissue engineering and ozone therapy. Nanodentistry provided the maintenance of the comprehensive oral health by employing nanomaterials for dentition re-naturalization, hypersensitivity cure, complete orthodontic realignments, covalently-bonded diamondized enamel, and continuous oral health maintenance using mechanical dentifrobots. Tissue engineering is a multidisciplinary approach that combines the principles of biology, medicine, and engineering to repair and/or regenerate a damaged tissue and/or organ by the interplay of three basic key elements: stem cells, morphogens and scaffolds. The integration of ozone in dentistry would exterminate the pain feeling during any dental treatment. Ozone has shown to stimulate remineralization of new caries-affected teeth. Garg and Tandon (2009) demonstrated that ozone therapy presents possible atraumatic, biologically-based treatment for situations faced in routine dental practice [1,2].

With advancement, diseases are now defined as genotype and/or phenotype with the potential for adverse consequences. Oral diseases need understanding genetic variability at greater level. The progression in disease diagnosis and treatment is determined by our growing skill in acquiring new data and efficient analysis. Genome is the complete set of genetic instructions carried within a single cell of an organism. It contains biological information encoded in its deoxyribonucleic acid (DNA) and is divided into discrete units called genes. Genes are pieces of DNA, which contain the information for making a specific protein. The genetic disorders related to dentistry can be due to a single gene or multiple genes causing alteration in genes interacting with environmental influences [3].

### Oral diseases caused due to single gene defect

**Congenital missing tooth:** During the tooth development multiple genes are expressed together to determine tooth type, location, and time of formation. For example - mutation in MSX1 and PAX9 gene can cause variable and unusual pattern during tooth development, leading to absence of tooth [4]. Hence, in genomic era, genetic testing

is advanced to determine the molecular basis of the condition and to establish the mode of inheritance and recurrence risk.

**Enamel defects:** Amelogenesis Imperfecta is genetically and clinically diverse group of hereditary conditions. The understanding of genotype/phenotype relationship of different enamel conditions will permit clinicians to accurately diagnose, predict prognosis and follow prime treatment approaches.

**Dentine defects:** Dentinogenesis Imperfecta includes numerous mutations in collagen type I and dentin-sialo-phospho-protein gene. The defect at chromosome 4q21 presents dentin dysplasia [5]. The phenotypic and histopathological classification is important for better treatment.

### Oral diseases caused due to multiple gene defect

**Wound healing:** This involves a complex interplay of cells, mediators, growth factors, and cytokines. Smad3 and Smad2 (nuclear transcriptional activators), are intracellular mediators of TGF- $\beta$  (transforming growth factor) which has been implicated as an important factor in the cellular proliferation, differentiation, and migration. Ashcroft et al. (1999) demonstrated Smad3 pathway in vivo, coupled with exogenous TGF signaling through intact alternate pathways and suggested its therapeutic benefit in healing impaired wound [6].

**Dental caries:** Most common multifactorial disease of oral cavity, which involve complex amalgamation of infectious microbial agents coupled with hereditary and environmental risk factors. Wright and Hart (2002) suggests that heredity plays an important role [3].

**Periodontal diseases:** Relationship between the specific gene defect and periodontitis susceptibility can be explained by assessing the relationship between the severe periodontitis with that of genetic diseases. Genes responsible for modifying the clinical expression of disease includes Cathepsin C gene, gamma receptor genotype, Vitamin D receptor polymorphisms, and immunoglobulin allotypes [7]. Aggressive periodontitis has complex etiology with hereditary being the foremost factor. Chronic disease results from additive effect of multiple genes, interactive effects with other gene products, and variations by environmental factors [8]. These are concerns that will gain more attention in future, as it is now realized that the capability to investigate for genetic polymorphisms exists.

**Cancer affecting head and neck:** Head and neck squamous cell carcinoma (HNSCC) is the most dreadful disease in the Asian continent. Genetic model determined the effect of multiple different gene polymorphisms and environmental exposure of agents as a risk factor for the head and neck squamous cell carcinoma (HNSCC) [9]. High level of expression of certain genes such as p63 (transcription factor), PNET (tumor suppressor gene), epidermal growth factor

receptor (EGFR), proliferating cell nuclear antigen (PCNA), p53 and cyclin D1 showed correlation with aggressiveness, recurrence and poor prognosis of HNSCC. A causal role of HPV-16 in HNSCC with expression of E6 and E7 oncogenes coupled with inactivation of pRB and p53 has been established. The tumors either demonstrated E6 gene expression or lacked p53 mutation or alternatively, they lacked E6 expression and expressed p53 mutations. Gene polymorphisms in CYP1A1, GSTM1 genes, and zinc finger protein 217 showed genetically high risk of HNSCC with associated tobacco habit. This presented difference in individual susceptibility to chemical carcinogens in assessing the risk of oral cancers [10].

Genomic advancement in dentistry should emphasize towards principles of fundamental genetic, genetic terminology, genetic transmission, population genetics, molecular biology of the human genome and their applications towards the patient care. It is therefore recommended that genomic knowledge should be demonstrated by a) Proper examination to rule out the signs of major genetic disorders b) Detailed family history c) Identify pattern of inheritance d) Calculate the risk factor e) Assess the need for genetic testing/screening f) Modify treatment according to the genetic conditions g) Collaborative work as a team. We propose that the oral health professionals should be oriented towards the genetic etiology and pathophysiology of the lesions with the potential to contribute for the new approaches in diagnosing, preventing and treating.

Significant information and diversity of the human genomic has led many questions without answer. These are – 1) Reliability and practicality of the fetal genetic testing 2) The concealment and confidentiality of the genetic information 3) Evaluation of the genetic test for its accuracy. These uncertainties present a questionable state about - genetic testing should be performed when no treatment is available? Are the parents of the minor children having the right to get tested for adult-onset diseases? [8].

Hence, we authors recommend that for the upcoming of oral health care and examination, an advanced step in resolving multifaceted oral diseases by the science, new schemes and upcoming knowledge from

people of other disciplines is mandatory. Also, the unsolved, perplexing and varying structural and functional integrity of the human genome still requires efficient prophylactic and curative therapies.

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