International Journal of Enhanced Research in Medicines & Dental Care (IJERMDC),
ISSN: 2349-1590, Vol. 6 Issue 9, September -2019, Impact Factor: 3.015

Review on Genetic Disorders and Its Effect on Craniofacial Structures

Dr. Kavita Bagri[1], Dr. Ritu Jain[2], Dr. Anju Malik[3], Dr. Sonam Rana[4]

[1]MDS (Orthodontics and Dentofacial Orthopedic Surgeon), Consultant Orthodontist at Saral Solution Dental Clinic, Faridabad
[2]MDS (Oral & Maxillofacial surgery), Consultant Oral Surgeon at Multi Specialty Dental Clinic Gurgaon)
[3]MDS (Orthodontics and Dentofacial Orthopedic Surgeon), Consultant Orthodontist at Daya Ram Hospital, Sonipat
[4]MDS (Periodontology), Consultant Periodontist at Family Dental Clinic, Delhi

ABSTRACT

A genetic disorder is a genetic problem caused by one or more abnormalities in the genome, especially a condition that is present from birth (congenital). Its also affected, skeletal jaw discrepancies, effect on malocclusion, pain in TMJ, impact on facial aesthetics, oral hygiene. It is most detrimental to the teeth and health of the jaw joints. This article described varies genetic disorder that effect on craniofacial structure of human being.

Key words: – Genes.

INTRODUCTION

The science of genetics is concerned with the inheritance of traits, whether normal or abnormal and with interaction of genes and the environment. Man as a superior form of life is just an expression of gene. His character complexion, face, the good and the bad all have been inscribed in his gene.

In the words of Richard Dawkins a scientist and Neo-Darwinism philosopher, the possibility that we are mere use and throw survival machines for our genes and that the ultimate utility function of life is nothing more glorious than the maximization of DNA survival. Most genetic disorders are quite rare and affect one person in every several thousands or millions.

Genetic disorders may be hereditary, passed down from the parents' genes. In other genetic disorders, defects may be caused by new mutations or changes to the DNA. [1]

Genetic disorders /syndromes classified in to 3 category

a) Chromosomal disorders-There is an abnormality in the number of structure of chromosome e.g. trisomy 2, monosomy of X or Cri-du-chat syndrome etc.

b) Multifactorial inheritance-In this, the disorder is a result of interaction of gene and environmental factors such as infectious agents, drugs or ionizing radiations etc. [2]

c) Single gene disorder-These are due to single mutant gene. They are also called Mendelian disorders. These have three patterns of inheritance.

- Autosomal dominant
- Autosomal recessive
- X-linked inheritance

AUTOSOMAL DOMINANT

Warrensburg Syndrome

Historical note*:*-In 1926 Mendel first reported the disorder and recognized its familial occurrence. In 1951 Warrensburg fully described the syndrome.

Facial feature- lateral displacement of the medial canthi, broad nasal bridge with hypoplastic ala nasi , medial eyebrow flare, hypochromic iridis.

Genetics-Autosomal dominant with Variable expressivity.[3]

OSTEOGENESIS IMPERFECTA

Historical note-In 1918 Van der Hoeve and de Kleijn emphasized brittle bones, blue sclera, and deafness as a syndrome. Osteogenesis imperfecta (OI) is a hereditary connective tissue disorder caused by type I collagen defects (Byers, 1993).

Growth –near to normal.

Dentition – hypoplasia of dentin and pulp with translucency of teeth , irregular placement and late eruption .

Sclera and skin – Thin skin and sclera and partial visualization of choroid gives blue appearance

Skeletal –fractures (92%), hyperextensible joints(100%), wormian bones in cranial sutures

Cephalometric findings- unique facial profile. Malocclusions became more dominant with increased age .QI patient have retarded vertical dimensions, a flattened cranial base angle, relative prognathism, larger facial divergence, and more forward counterclockwise growth of mandibular

Genetics-Ninety percent seem to have an autosomal dominant mode of transmission with blue sclera and a good prognosis. Lethal form exists with parental consanguinity and recessive inheritance. Estimated frequency of lethal recessive form 1 in. 40,000 births.[4]

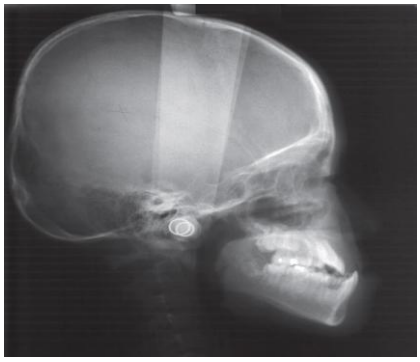


Fig-1: lateral cephalogram

MANDIBULOFACIAL DYSOSTOSIS (TREACHER COLLINS SYNDROME)

Historical note-This syndrome was probably first described in 1846 by Thomson Berry. In 1900 Treacher Collins described the main features of the syndrome which now bears his name.[5]

Abnormalities

Antimongoloid slanting palpebral fissures	89%
Malar hypoplasia with or without cleft in zygomatic bone	81%
Mandibular hypoplasia	78%
Lower lid coloboma	69%
Partial to total absence of lower eyelashes	53%
aMalformation of auricle	77%

external ear canal defect	36%
Conductive deafness	40%
Visual loss	37%
Cleft Palate	28%
Incomplete soft palate	28%

Cephalometric findings- decreased anterior, posterior, and total cranial base lengths, reduced cranial base angle. maxilla is positioned posteriorly with respect to the cranial base , anterior and posterior facial heights are decreased, Lower face height is increased. The maxillary and functional occlusal planes are tipped upwards posteriorly. The mandibular plane angle and gonial angle are increased. The mandible is retropositioned.

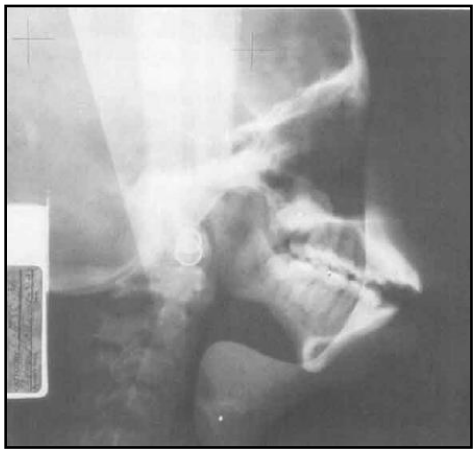


Fig-2: lateral cephalogram

Genetics
Autosomal dominant trait with incomplete penetrance, Variable expressibility.

GARDNER SYNDROME

Historical note -In 1953 Gardner and co-workers recognized the disorder as a syndrome and studied its genetic mode of transmission.

Facial Features -Osteomas involving mandible and frontal bones may deform face, Most osteomas present around puberty and usually precede intestinal polyps, Epidermoid inclusion cysts may involve face, Multiple odontomas

Genetics-Autosomal dominant and shows variable expressivity. [6]

CROUZON SYNDROME (CRANIOFACIAL DYSOSTOSIS)

Historical note-In 1912 Crouzon first described a woman and her son with this disorder

Abnormalities

Craniofacial –Ocular proptosis, hypertelorism; frontal bossing ,exposure conjuctivities or key keratitis; unexplained poor visual acuity; hypoplasia of maxilla with or without curved parrot like nose , inverted V shape to palate; conductive hearing loss; short anteroposterior and wide lateral dimensions of the cranium may occur. cleft lip with or without cleft palate ; bifid uvula.[7,8]

Cephalometric findings There is reduction in pharyngeal height, width and depth; increased length and thickness of the velum; decreased length of the hard palate and marked reduction in the posterior cranial base with somewhat less remarkable changes in the anterior cranial base(fig 28) and the maxilla is hypoplasic.

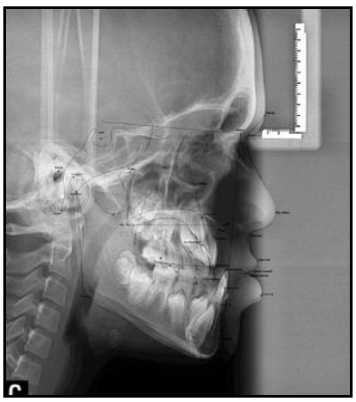


Fig 3: Hard and soft tissue analysis on lateral cephalogram of the child

Genetics-Autosomal dominant with Wide range of expressivity, About one third of reported cases arise as a new mutation.

CHERUBISM

Historical note-Cherubism is a descriptive term coined by Jones in 1933 to describe a rare facial deformity.

Facial features: Bilateral fullness of cheeks with painless swelling of submandibular regions, Deformity usually detectable between 1½ and 7 years of age, Hypertelorism, Irregularly plated deciduous teeth, Rim of sclera commonly visible beneath iris because of upward displacement of globe. [9]

Radiographic findings-Multiocular radiolucencies involving the ramus and posterior part of the body of the mandible were visible on the right lateral cephalogram . The vertical depth on the mandible is larger than normal. The lateral cephalogram showed that the mandible is enlarged with cystic lesions. The panoramic reveals that bilateral multiocular radiolucencies involving the mandible with spacing of teeth in lower arch(fig 4).

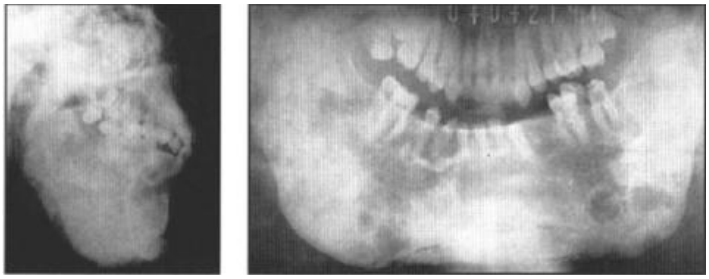


Fig 4: .Lateral cephalogram and panoramic image of a patient showing multiocular radiolucenties involving mandible.

Genetics -Rare disorder, less than seventy cases as of 1970 ,Autosomal dominant with variable expressivity

AUTOSOMAL RECESSIVE

Sjogren-Larsson Syndrome

Historical note-In 1957 Sjogren and Larsson first described a syndrome consisting of congenital ichthyosis, spastic paralysis, mental retardation, and, less frequently, degenerative retinitis.

Facial features-Moderate hyperkeratosis and scaling of face and scalp, , Defects of tooth enamel sometimes present, Increased separation between teeth,Speech impediments, Pigmentary degeneration of retina, , Flat nose, wide at base

Genetics: Autosomal recessive, Frequent history of parental consanguinity.[10]

ELLIS-VAN CREVELD SYNDROME (CHONDROECTODERMAL DYSPLASIA)

Historical note- In 1940 Ellis and van Creveld described three infants with this disorder.

Facial features- Short upper lip, Upper lip bound by frenulum to the maxillary gingival, Often multiple frenula, Defects in lower alveolar ridge, Neonatal teeth, Malformed teeth, irregularly spaced.

Genetics-A rare disorderand shows autosomal recessive inheritance. .[11]

X-linked inheritance

XO TURNER SYNDROME (GONADAL DYSGENESIS)

Historical note-In 1938 Turner described the classic features of this syndrome in seven females with short stature, cubitus valgus, webbed neck, and sexual infantilism. In 1954 Polani and co-workers and Wilkins and associates noted sex chromatin to be absent in these patients .In 1959 Ford and co-workers discovered that there was a missing X chromosome.

Facial features
Facies shows premature aging, Face frequently heart-shaped, Multiple eye findings including ptosis, cataract, strabismus, epicanthus, blue sclera, and corneal nebulae, Color blindness same frequency as males (7%), Depressed corners of mouth, High-arched palate, Dental malocclusion, Micrognathia, Prominent ears, often low-set.

Genetics
Over 95% of 45XO fetuses die in utero - 5% of all spontaneous abortions
Prevalence at time of conception may vary from 1 in 200 to 1 in 50, at time of birth 1 in 2,500 female live births
X chromosome present in most cases (72%) of maternal origin.
No evidence that maternal age is a factor. .[12]

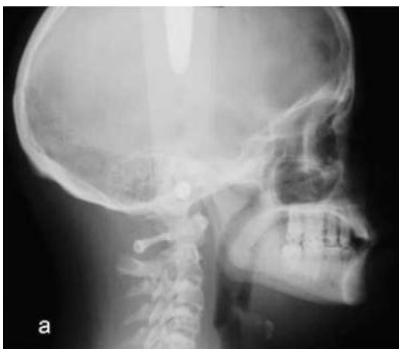
TRISOMY SYNDROME (DOWN SYNDROME, MONGOLISM)

Historical note
In 1866 Langdon Down first adequately described this syndrome
In 1959 Lejeune and co-workers first reported the chromosomal abnormality.

Abnormalities
Craniofacial – Brachecephaly with relatively flat occiput and tendency toward midline parietal hair whorl; mild microcephaly with upslanting palpebral fissures ;thin cranium with late closure of fontanels; hypoplasia to aplasia of frontal sinusis , short hard palate ; small nose with low nasal bridge and tendency to have inner epicanthal folds..

Dentition - Hypoplasia , irregular placement , fewer caries than usual. Periodontal disease.

Cephalometric findings-Cephalometric analysis reveals that these patients have deficiency and the cranial base found to be flatter and shorter on its anterior site , along with the general reduction in linear maxillary and mandibular length as well as anterior facial heights. Despite the highly compromised maxillary length, the sagittal relationship was observed to be so expressive in the face of Down syndrome children because of the overall reduction of craniofacial dimensions.



. Fig 5: Lateral cephalogram of a down syndrome patient.

Genetics
Trisomy 21 accounts for about 95% of cases of Down syndrome.[13]

CONCLUSION

At the present time successful interception and treatment of hereditary malocclusion are limited by the extent of our knowledge because of a) lack of research dedicated to this particular problem e.g., prospective randomized clinical trials. b)relative blunt measurement tools.c)limited knowledge about the genetic mechanisms involved and the precise nature and effects of environmental influences, we are unable to predict with a satisfactory degree of certainty the final manifestation of the growth pattern or the severity of the malocclusion conferred by a particular genotype.

On the genetics side the advent of diagnostic techniques in the field of molecular genetics make it possible to identify relevant morphogenes or genetic markers such as those for mandibular prognathism or to influence the development of malocclusion. It is therefore incumbent on the orthodontic specialty to keep abreast of developments in molecular genetics.

REFERENCES

[1] Lewisr(2005).Human Genetics.Concepts And Applications.9th Edition
[2] hunter dj(2005).gene-enviroment interactions in human diseases.nature reviews genetics,6(4),287-298
[3] *Arias S (1971). "Genetic Heterogeneity in the Waardenburg Syndrome". Birth Defects Original Article Series.* ***7*** *(4): 87–101. PMID 5006208*
[4] Osteogenesis imperfecta: the molecular basis of clinical heterogeneity.Byers PH, Bonadio JF, Cohn DH, Starman BJ, Wenstrup RJ, Willing MC,Ann N Y Acad Sci. 1988; 543():117-28.
[5] *Treacher Collins syndrome". Genetics Home Reference. June 2012. Retrieved 7 November 2017*
[6] *Gardner EJ (June 1951). "A genetic and clinical study of intestinal polyposis, a predisposing factor for carcinoma of the colon and rectum". Am. J. Hum. Genet.* ***3*** *(2): 167–76. PMC 1716321. PMID 14902760.*
[7] *Crouzon syndrome | Genetic and Rare Diseases Information Center (GARD) – an NCATS Program". rarediseases.info.nih.gov. Retrieved 21 November 2018.*
[8] *^ "Crouzon Syndrome - NORD (National Organization for Rare Disorders)". NORD (National Organization for Rare Disorders). Retrieved 21 November 2018 Jones, W. A.; Gerrie, J.; Pritchard, J. (1950). "*
[9] *Cherubism--familial fibrous dysplasia of the jaws". The Journal of Bone and Joint Surgery. British Volume.* ***32-B*** *(3): 334–347.*
[10] *SJOGREN T, LARSSON T (1957). "Oligophrenia in combination with congenital ichthyosis and spastic disorders; a clinical and genetic study". Acta Psychiatr Neurol Scand Suppl.* ***113****: 1–112.*
[11] *Badano, Jose L.; Norimasa Mitsuma; Phil L. Beales; Nicholas Katsanis (September 2006). "The Ciliopathies : An Emerging Class of Human Genetic Disorders". Annual Review of Genomics and Human Genetics.* ***7****: 125–148.*
[12] *"Turner Syndrome: Overview". Eunice Kennedy Shriver National Institute of Child Health and Human Development. 3 April 2013. Archived from the original on 2 April 2015. Retrieved 15 March 2015*
[13] *Malt, EA; Dahl, RC; Haugsand, TM; Ulvestad, IH; Emilsen, NM; Hansen, B; Cardenas, YE; Skøld, RO; Thorsen, AT; Davidsen, EM (Feb 5, 2013). "Health and disease in adults with Down syndrome". Tidsskrift for den Norske Laegeforening : Tidsskrift for Praktisk Medicin, NY Raekke.* ***133*** *(3): 290–94.*

.