RUNX2

Subjects: Genetics & Heredity
Contributor: Karina Chen

runt related transcription factor 2

genes

1. Normal Function

The *RUNX2* gene provides instructions for making a protein that is involved in the development and maintenance of the teeth, bones, and cartilage. Cartilage is a tough, flexible tissue that makes up much of the skeleton during early development. Most cartilage is later converted to bone (a process called ossification), except for the cartilage that continues to cover and protect the ends of bones and is present in the nose, airways, and external ears.

The RUNX2 protein is a transcription factor, which means it attaches (binds) to specific regions of DNA and helps control the activity of particular genes. Researchers believe that the RUNX2 protein acts as a "master switch," regulating a number of other genes involved in the development of cells that build bones (osteoblasts) and in the development of teeth.

2.2. Health Conditions Related to Genetic Changes

2.1. Cleidocranial dysplasia

About 200 mutations in the *RUNX2* gene have been identified in individuals with cleidocranial dysplasia, a condition that primarily affects development of the bones and teeth. Some mutations change one protein building block (amino acid) in the RUNX2 protein. Other mutations introduce a premature stop signal that results in an abnormally short, nonfunctional protein. Occasionally, the entire gene is missing.

These genetic changes reduce or eliminate the activity of the protein produced from one copy of the *RUNX2* gene in each cell, decreasing the total amount of functional RUNX2 protein. This shortage of functional RUNX2 protein interferes with the normal development of bones, cartilage, and teeth, resulting in the signs and symptoms of cleidocranial dysplasia. In rare cases, individuals with a deletion of genetic material that includes *RUNX2* and other nearby genes may experience additional features, such as developmental delay, resulting from the loss of these genes.

2.2. Other disorders

An extra copy (duplication) of a segment of the *RUNX2* gene causes a disorder called metaphyseal dysplasia, maxillary hypoplasia, and brachydactyly (MDMHB). This condition is characterized by abnormalities near the ends of long bones (metaphyses), an underdeveloped upper jawbone (maxilla), and short fingers (brachydactyly). Other skeletal abnormalities can also occur in this disorder. Research suggests that the extra genetic material in one copy of the *RUNX2* gene in each cell alters the function of the RUNX2 protein, and may interfere with the maturation of cells that build bones (osteoblasts). However, the relationship between the altered RUNX2 function and the specific signs and symptoms of MDMHB is unclear.

3. Other Names for This Gene

- CBF-alpha 1
- CBFA1
- CCD
- CCD1
- core-binding factor, runt domain, alpha subunit 1
- MGC120022
- MGC120023
- OSF2
- osteoblast-specific transcription factor 2
- PEBP2aA
- polyomavirus enhancer binding protein 2 alpha A subunit
- RUNX2_HUMAN
- SL3-3 enhancer factor 1 alpha A subunit
- SL3/AKV core-binding factor alpha A subunit

The entry is from https://medlineplus.gov/genetics/gene/runx2

References

1. Avela K, Hirvinen H, Ben Amor M, Rauch F. Metaphyseal dysplasia with maxillaryhypoplasia and brachydactyly in a Finnish woman: first confirmation of aduplication in RUNX2 as pathogenic variant. Eur J Med Genet. 2014Nov-Dec;57(11-12):617-20.
2. Bruderer M, Richards RG, Alini M, Stoddart MJ. Role and regulation of RUNX2 inosteogenesis. Eur Cell Mater. 2014 Oct 23;28:269-86. Review.
3. Bufalino A, Paranaíba LM, Gouvêa AF, Gueiros LA, Martelli-Júnior H, Junior JJ,Lopes MA, Graner E, De Almeida OP, Vargas PA, Coletta RD. Cleidocranialdysplasia: oral features and genetic analysis of 11 patients. Oral Dis. 2012Mar;18(2):184-90. doi: 10.1111/j.1601-0825.2011.01862.x. Epub 2011 Oct 24.

4. Cohen MM Jr. Biology of RUNX2 and Cleidocranial Dysplasia. J Craniofac Surg.2013 Jan;24(1):130-3. doi: 10.1097/SCS.0b013e3182636b7e. Review.
5. D'Alessandro G, Tagariello T, Piana G. Cleidocranial dysplasia: etiology andstomatognathic and craniofacial abnormalities. Minerva Stomatol. 2010Mar;59(3):117-27. Review. English, Italian.
6. Dinçsoy Bir F, Dinçkan N, Güven Y, Baş F, Altunoğlu U, Kuvvetli SS, PoyrazoğluŞ, Toksoy G, Kayserili H, Uyguner ZO. Cleidocranial dysplasia: Clinical,endocrinologic and molecular findings in 15 patients from 11 families. Eur J Med Genet. 2017 Mar;60(3):163-168. doi: 10.1016/j.ejmg.2016.12.007. Epub 2016 Dec 24.
7. Jaruga A, Hordyjewska E, Kandzierski G, Tylzanowski P. Cleidocranial dysplasiaand RUNX2-clinical phenotype-genotype correlation. Clin Genet. 2016Nov;90(5):393-402. doi: 10.1111/cge.12812. Epub 2016 Jun 30. Review.
8. Machol K, Mendoza-Londono R, Lee B. Cleidocranial Dysplasia Spectrum Disorder.2006 Jan 3 [updated 2017 Nov 16]. In: Adam MP, Ardinger HH, Pagon RA, Wallace SE,Bean LJH, Stephens K, Amemiya A, editors. GeneReviews® [Internet]. Seattle (WA): University of Washington, Seattle; 1993-2020. Available fromhttp://www.ncbi.nlm.nih.gov/books/NBK1513/
9. Moffatt P, Ben Amor M, Glorieux FH, Roschger P, Klaushofer K, SchwartzentruberJA, Paterson AD, Hu P, Marshall C; FORGE Canada Consortium, Fahiminiya S,Majewski J, Beaulieu CL, Boycott KM, Rauch F. Metaphyseal dysplasia withmaxillary hypoplasia and brachydactyly is caused by a duplication in RUNX2. Am J Hum Genet. 2013 Feb 7;92(2):252-8. doi: 10.1016/j.ajhg.2012.12.001. Epub 2013 Jan3.
10. Vimalraj S, Arumugam B, Miranda PJ, Selvamurugan N. Runx2: Structure,function, and phosphorylation in osteoblast differentiation. Int J Biol Macromol.2015;78:202-8. doi: 10.1016/j.ijbiomac.2015.04.008. Epub 2015 Apr 13. Review.
11. Wysokinski D, Pawlowska E, Blasiak J. RUNX2: A Master Bone Growth RegulatorThat May Be Involved in the DNA Damage Response. DNA Cell Biol. 2015May;34(5):305-15. doi: 10.1089/dna.2014.2688. Epub 2015 Jan 2. Review.