RUNX2 gene

runt related transcription factor 2

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.

Health Conditions Related to Genetic Changes

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.

Other disorders

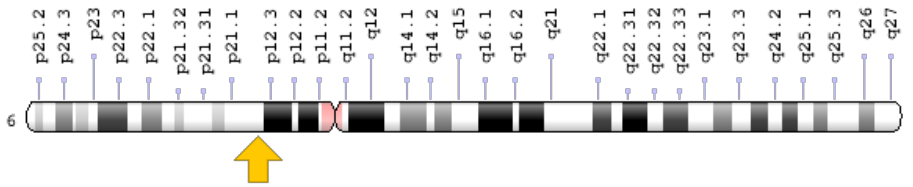
An extra copy (duplication) of a segment of the *RUNX2* gene causes a disorder called metaphyseal dysplasia, maxillary hypoplasia, and brachydactyly (MDMHB). This condition is characterized by abnormalities near the ends of long bones (metaphyses), an underdeveloped upper jawbone (maxilla), and short 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.

Chromosomal Location

Cytogenetic Location: 6p21.1, which is the short (p) arm of chromosome 6 at position 21.1

Molecular Location: base pairs 45,328,317 to 45,551,082 on chromosome 6 (Homo sapiens Annotation Release 109, GRCh38.p12) (NCBI)



Credit: Genome Decoration Page/NCBI

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

Additional Information & Resources

Educational Resources

- Developmental Biology (sixth edition, 2000): Osteogenesis: The Development of Bones
  https://www.ncbi.nlm.nih.gov/books/NBK10056/

GeneReviews

- Cleidocranial Dysplasia Spectrum Disorder
  https://www.ncbi.nlm.nih.gov/books/NBK1513

Scientific Articles on PubMed

- PubMed
  https://www.ncbi.nlm.nih.gov/pubmed?term=%28%28RUNX2%5BTIAB%5D%29+OR+%28runt-related+transcription+factor+2%5BTIAB%5D%29%29+AND+%28%28Genes%5BMH%5D%29+OR+%28Genetic+Phenomena%5BMH%5D%29%29+AND+english%5Bla%5D+AND+human%5Bmh%5D+AND+%22last+360+days%22%5Bdp%5D

OMIM

- METAPHYSEAL DYSPLASIA WITH MAXILLARY HYPOPLASIA WITH OR WITHOUT BRACHYDACTYLY
  http://omim.org/entry/156510
- RUNT-RELATED TRANSCRIPTION FACTOR 2
  http://omim.org/entry/600211

Research Resources

- Atlas of Genetics and Cytogenetics in Oncology and Haematology
  http://atlasgeneticsoncology.org/Genes/RUNX2ID42183ch6p21.html
- ClinVar
  https://www.ncbi.nlm.nih.gov/clinvar?term=RUNX2%5Bgene%5D
- HGNC Gene Symbol Report
  https://www.genenames.org/cgi-bin/gene_symbol_report?q=data/hgnc_data.php&hgnc_id=10472
- NCBI Gene
  https://www.ncbi.nlm.nih.gov/gene/860
- UniProt
  http://www.uniprot.org/uniprot/Q13950

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