

## RUNX2 gene

RUNX family 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.

### 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

#### Tests Listed in the Genetic Testing Registry

- Tests of RUNX2 ([https://www.ncbi.nlm.nih.gov/gtr/all/tests/?term=860\[geneid\]](https://www.ncbi.nlm.nih.gov/gtr/all/tests/?term=860[geneid]))

#### Scientific Articles on PubMed

- PubMed (<https://pubmed.ncbi.nlm.nih.gov/?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>)

#### Catalog of Genes and Diseases from OMIM

- METAPHYSEAL DYSPLASIA WITH MAXILLARY HYPOPLASIA WITH OR WITHOUT BRACHYDACTYLY; MDMHB (<https://omim.org/entry/156510>)
- RUNT-RELATED TRANSCRIPTION FACTOR 2; RUNX2 (<https://omim.org/entry/600211>)

### Gene and Variant Databases

- NCBI Gene (<https://www.ncbi.nlm.nih.gov/gene/860>)
- ClinVar ([https://www.ncbi.nlm.nih.gov/clinvar?term=RUNX2\[gene\]](https://www.ncbi.nlm.nih.gov/clinvar?term=RUNX2[gene]))

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## Genomic Location

The *RUNX2* gene is found on chromosome 6 (<https://medlineplus.gov/genetics/chromosome/6/>).

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