



## TGFB1 gene

transforming growth factor beta 1

### Normal Function

The *TGFB1* gene provides instructions for producing a protein called transforming growth factor beta-1 (TGF $\beta$ -1). The TGF $\beta$ -1 protein triggers chemical signals that regulate various cell activities inside the cell, including the growth and division (proliferation) of cells, the maturation of cells to carry out specific functions (differentiation), cell movement (motility), and controlled cell death (apoptosis).

The TGF $\beta$ -1 protein is found throughout the body but is particularly abundant in tissues that make up the skeleton, where it helps regulate the formation and growth of bone and cartilage, a tough, flexible tissue that makes up much of the skeleton during early development. TGF $\beta$ -1 is also involved in the formation of blood vessels, development of muscle tissue and body fat, wound healing, inflammatory processes in the immune system, and prevention of tumor growth.

### Health Conditions Related to Genetic Changes

#### Camurati-Engelmann disease

At least 12 mutations in the *TGFB1* gene have been found to cause Camurati-Engelmann disease. This condition is characterized by abnormally thick bones (hyperostosis) in the arms, legs, and skull. Hyperostosis can cause bone pain, muscle weakness, and increased pressure on the brain that results in neurological problems, including headaches and hearing and vision problems.

Most of the *TGFB1* gene mutations change single protein building blocks (amino acids) in the TGF $\beta$ -1 protein. Three mutations account for approximately 75 percent of cases of Camurati-Engelmann disease. Two of these mutations change the amino acid arginine at position 218 in the protein. One replaces arginine with the amino acid cysteine (written as Arg218Cys or R218C) and the other replaces arginine with the amino acid histidine (written as Arg218His R218H). The third mutation replaces the amino acid cysteine with the amino acid arginine at protein position 225 (written as Cys225Arg C225R).

All *TGFB1* gene mutations that cause Camurati-Engelmann disease result in the production of an overly active TGF $\beta$ -1 protein. This abnormal TGF $\beta$ -1 protein activity causes an increase in signal transduction, which leads to more bone formation. As a result, the bones in the arms, legs, and skull are thicker than normal, contributing

to the movement and neurological problems often experienced by individuals with Camurati-Engelmann disease.

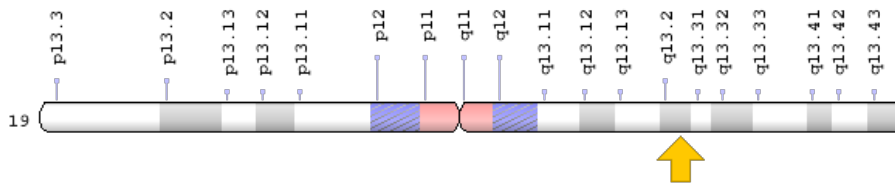
### Cancers

Changes in the *TGFB1* gene have been reported to be associated with certain cancers. These variants are acquired during a person's lifetime and are present only in certain cells. Studies have shown that *TGFB1* gene variants are associated with breast, colorectal, lung, liver, and prostate cancer. The altered protein expression may increase several cell processes that promote cancer formation such as cell proliferation, cell motility, and the development of new blood vessels (angiogenesis) that nourish a growing tumor.

### Chromosomal Location

Cytogenetic Location: 19q13.2, which is the long (q) arm of chromosome 19 at position 13.2

Molecular Location: base pairs 41,330,323 to 41,353,922 on chromosome 19 (Homo sapiens Updated Annotation Release 109.20190607, GRCh38.p13) (NCBI)



Credit: Genome Decoration Page/NCBI

### Other Names for This Gene

- TGF-beta-1
- TGF-beta 1 protein
- TGFB
- TGFB1\_HUMAN
- TGFbeta
- transforming growth factor, beta 1

## **Additional Information & Resources**

### Educational Resources

- Cancer Medicine (sixth edition, 2003): Transforming Growth Factor- $\beta$  (TGF- $\beta$ )  
<https://www.ncbi.nlm.nih.gov/books/NBK12565/#A4309>
- Eureka Bioscience Collection: TGF $\beta$  Signaling  
<https://www.ncbi.nlm.nih.gov/books/NBK6525/#A31193>
- Molecular Cell Biology (fourth edition, 2000): TGF $\beta$  Signaling Pathway (image)  
<https://www.ncbi.nlm.nih.gov/books/NBK21715/?rendertype=figure&id=A6758>

### Clinical Information from GeneReviews

- Camurati-Engelmann Disease  
<https://www.ncbi.nlm.nih.gov/books/NBK1156>

### Scientific Articles on PubMed

- PubMed  
<https://www.ncbi.nlm.nih.gov/pubmed?term=%28%28TGFB1%5BTI%5D%29+OR+%28TGF+beta-1%5BTI%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+1800+days%22%5Bdp%5D>

### Catalog of Genes and Diseases from OMIM

- TRANSFORMING GROWTH FACTOR, BETA-1  
<http://omim.org/entry/190180>

### Research Resources

- Atlas of Genetics and Cytogenetics in Oncology and Haematology  
<http://atlasgeneticsoncology.org/Genes/TGFB1ID42534ch19q13.html>
- Cancer Genetics Web  
<http://www.cancerindex.org/geneweb/TGFB1.htm>
- ClinVar  
<https://www.ncbi.nlm.nih.gov/clinvar?term=TGFB1%5Bgene%5D>
- HGNC Gene Symbol Report  
[https://www.genenames.org/data/gene-symbol-report/#!/hgnc\\_id/HGNC:11766](https://www.genenames.org/data/gene-symbol-report/#!/hgnc_id/HGNC:11766)
- Monarch Initiative  
<https://monarchinitiative.org/gene/NCBIGene:7040>

- NCBI Gene  
<https://www.ncbi.nlm.nih.gov/gene/7040>
- UniProt  
<https://www.uniprot.org/uniprot/P01137>

## Sources for This Summary

- Eureka Bioscience Collection: Transforming Growth Factor- $\beta$   
<https://www.ncbi.nlm.nih.gov/books/NBK6579/#A38370>
- Fujio K, Komai T, Inoue M, Morita K, Okamura T, Yamamoto K. Revisiting the regulatory roles of the TGF- $\beta$  family of cytokines. *Autoimmun Rev.* 2016 Sep;15(9):917-22. doi: 10.1016/j.autrev.2016.07.007. Epub 2016 Jul 5. Review.  
*Citation on PubMed:* <https://www.ncbi.nlm.nih.gov/pubmed/27392504>
- Janssens K, Vanhoenacker F, Bonduelle M, Verbruggen L, Van Maldergem L, Ralston S, Guañabens N, Migone N, Wientroub S, Divizia MT, Bergmann C, Bennett C, Simsek S, Melançon S, Cundy T, Van Hul W. Camurati-Engelmann disease: review of the clinical, radiological, and molecular data of 24 families and implications for diagnosis and treatment. *J Med Genet.* 2006 Jan; 43(1):1-11. Epub 2005 May 13. Review.  
*Citation on PubMed:* <https://www.ncbi.nlm.nih.gov/pubmed/15894597>  
*Free article on PubMed Central:* <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2564495/>
- Janssens K, ten Dijke P, Ralston SH, Bergmann C, Van Hul W. Transforming growth factor-beta 1 mutations in Camurati-Engelmann disease lead to increased signaling by altering either activation or secretion of the mutant protein. *J Biol Chem.* 2003 Feb 28;278(9):7718-24. Epub 2002 Dec 18.  
*Citation on PubMed:* <https://www.ncbi.nlm.nih.gov/pubmed/12493741>
- Long J, Liu Z, Wu X, Xu Y, Ge C. Gene expression profile analysis of pancreatic cancer based on microarray data. *Mol Med Rep.* 2016 May;13(5):3913-9. doi: 10.3892/mmr.2016.5021. Epub 2016 Mar 21.  
*Citation on PubMed:* <https://www.ncbi.nlm.nih.gov/pubmed/27035876>  
*Free article on PubMed Central:* <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4838162/>
- Ma X, Chen C, Xiong H, Li Y. Transforming growth factor $\beta$ 1 L10P variant plays an active role on the breast cancer susceptibility in Caucasian: evidence from 10,392 cases and 11,697 controls. *Breast Cancer Res Treat.* 2010 Nov;124(2):453-7. doi: 10.1007/s10549-010-0843-x. Epub 2010 Mar 27. Review.  
*Citation on PubMed:* <https://www.ncbi.nlm.nih.gov/pubmed/20349130>
- Poniatowski LA, Wojdasiewicz P, Gasik R, Szukiewicz D. Transforming growth factor Beta family: insight into the role of growth factors in regulation of fracture healing biology and potential clinical applications. *Mediators Inflamm.* 2015;2015:137823. doi: 10.1155/2015/137823. Epub 2015 Jan 29. Review.  
*Citation on PubMed:* <https://www.ncbi.nlm.nih.gov/pubmed/25709154>  
*Free article on PubMed Central:* <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4325469/>
- OMIM: TRANSFORMING GROWTH FACTOR, BETA-1  
<http://omim.org/entry/190180>
- Wallace SE, Lachman RS, Mekikian PB, Bui KK, Wilcox WR. Marked phenotypic variability in progressive diaphyseal dysplasia (Camurati-Engelmann disease): report of a four-generation pedigree, identification of a mutation in TGFB1, and review. *Am J Med Genet A.* 2004 Sep 1; 129A(3):235-47.  
*Citation on PubMed:* <https://www.ncbi.nlm.nih.gov/pubmed/15326622>

- Walton KL, Makanji Y, Chen J, Wilce MC, Chan KL, Robertson DM, Harrison CA. Two distinct regions of latency-associated peptide coordinate stability of the latent transforming growth factor-beta1 complex. *J Biol Chem*. 2010 May 28;285(22):17029-37. doi: 10.1074/jbc.M110.110288. Epub 2010 Mar 22.  
*Citation on PubMed:* <https://www.ncbi.nlm.nih.gov/pubmed/20308061>  
*Free article on PubMed Central:* <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2878044/>
  - Zhao L, Hantash BM. TGF- $\beta$ 1 regulates differentiation of bone marrow mesenchymal stem cells. *Vitam Horm*. 2011;87:127-41. doi: 10.1016/B978-0-12-386015-6.00042-1. Review.  
*Citation on PubMed:* <https://www.ncbi.nlm.nih.gov/pubmed/22127241>
- 

Reprinted from Genetics Home Reference:  
<https://ghr.nlm.nih.gov/gene/TGFB1>

Reviewed: November 2017  
Published: September 10, 2019

Lister Hill National Center for Biomedical Communications  
U.S. National Library of Medicine  
National Institutes of Health  
Department of Health & Human Services