

## PADI3 gene

peptidyl arginine deiminase 3

### Normal Function

The *PADI3* gene provides instructions for making an enzyme called peptidylarginine deiminase type III. This enzyme modifies proteins by changing certain protein building blocks (amino acids). Specifically, it changes the positively charged amino acid arginine to the neutral amino acid citrulline when positively charged calcium atoms (ions) are present. This process is called deimination. In most cases, deimination alters the protein's interactions with other proteins.

Peptidylarginine deiminase type III is found in the skin's tough outer surface (the stratum corneum), within cells called keratinocytes. The protein also functions in hair follicles, which are specialized structures in the skin where hair growth occurs. In hair follicles, peptidylarginine deiminase type III modifies proteins involved in giving structure to the hair strand (shaft).

### Health Conditions Related to Genetic Changes

#### Uncombable hair syndrome

At least nine mutations in the *PADI3* gene have been found to cause uncombable hair syndrome. This condition is characterized by dry, frizzy, blond scalp hair that cannot be combed flat. This condition usually improves over time, and by adolescence individuals with uncombable hair syndrome have hair that lies flat and has normal or nearly normal texture.

The *PADI3* gene mutations likely result in a peptidylarginine deiminase type III enzyme with little or no activity. As a result, the enzyme cannot deiminate other proteins. In particular, peptidylarginine deiminase type III cannot deiminate a protein within the hair shaft called trichohyalin. Trichohyalin needs this modification so that it can attach (bind) to other proteins, giving the hair shaft its cylindrical shape. Without deimination of trichohyalin, the cross-section of the hair shaft becomes triangular, heart-like, or flat. These angular hair shafts result in frizzy hair that will not lie flat, which is typical of uncombable hair syndrome.

## Other Names for This Gene

- PAD3
- PDI3
- peptidyl arginine deiminase, type III
- peptidylarginine deiminase III
- protein-arginine deiminase type III
- protein-arginine deiminase type-3

## Additional Information & Resources

### Tests Listed in the Genetic Testing Registry

- Tests of PADI3 ([https://www.ncbi.nlm.nih.gov/gtr/all/tests/?term=51702\[geneid\]](https://www.ncbi.nlm.nih.gov/gtr/all/tests/?term=51702[geneid]))

### Scientific Articles on PubMed

- PubMed (<https://pubmed.ncbi.nlm.nih.gov/?term=%28%28PADI3%5BTIAB%5D%29+OR+%28peptidyl+arginine+deiminase+3%5BTIAB%5D%29%29+OR+%28PAD3%5BTIAB%5D%29+AND+%28%28Genes%5BMH%5D%29+OR+%28Genetic+Phenomena%5BMH%5D%29%29+AND+english%5Bla%5D+AND+human%5Bmh%5D+AND+%22last+3600+days%22%5Bdp%5D%29%29>)

### Catalog of Genes and Diseases from OMIM

- PEPTIDYLARGININE DEIMINASE, TYPE III; PADI3 (<https://omim.org/entry/606755>)

### Gene and Variant Databases

- NCBI Gene (<https://www.ncbi.nlm.nih.gov/gene/51702>)
- ClinVar ([https://www.ncbi.nlm.nih.gov/clinvar?term=PADI3\[gene\]](https://www.ncbi.nlm.nih.gov/clinvar?term=PADI3[gene]))

## References

- Calderon P, Otberg N, Shapiro J. Uncombable hair syndrome. J Am Acad Dermatol. 2009 Sep;61(3):512-5. doi: 10.1016/j.jaad.2009.01.006. Citation on PubMed (<https://pubmed.ncbi.nlm.nih.gov/19700017>)
- Dong S, Kanno T, Yamaki A, Kojima T, Shiraiwa M, Kawada A, Mechin MC, Chavanas S, Serre G, Simon M, Takahara H. NF-Y and Sp1/Sp3 are involved in the transcriptional regulation of the peptidylarginine deiminase type III gene (PADI3) in human keratinocytes. Biochem J. 2006 Aug 1;397(3):449-59. doi:10.1042/

BJ20051939. Citation on PubMed (<https://pubmed.ncbi.nlm.nih.gov/16671893>) or Free article on PubMed Central (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1533312/>)

- U Basmanav FB, Cau L, Tafazzoli A, Mechin MC, Wolf S, Romano MT, Valentin F, Wiegmann H, Hucheng A, Kandil R, Garcia Bartels N, Kilic A, George S, Ralser DJ, Bergner S, Ferguson DJP, Oprisoreanu AM, Wehner M, Thiele H, Altmuller J, Nurnberg P, Swan D, Houniet D, Buchner A, Weibel L, Wagner N, Grimalt R, Bygum A, Serre G, Blume-Peytavi U, Sprecher E, Schoch S, Oji V, Hamm H, Farrant P, Simon M, Betz RC. Mutations in Three Genes Encoding Proteins Involved in Hair Shaft Formation Cause Uncombable Hair Syndrome. *Am J Hum Genet.* 2016 Dec 1; 99(6):1292-1304. doi: 10.1016/j.ajhg.2016.10.004. Epub 2016 Nov 17. Citation on PubMed (<https://pubmed.ncbi.nlm.nih.gov/27866708>) or Free article on PubMed Central (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5142115/>)

## Genomic Location

The *PADI3* gene is found on chromosome 1 (<https://medlineplus.gov/genetics/chromosome/1/>).

**Last updated May 1, 2017**