

# Difference Between Oncogenes and Proto Oncogenes

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## Key Difference – Oncogenes vs Proto Oncogenes

Cells divide by mitosis and meiosis. Gametes are formed by meiosis, and somatic cells are produced by mitosis. The cell cycle is a highly regulated process which results in new cells or daughter cells from the mature cells. Different types of regulatory proteins are involved in the cell cycle. These proteins (cell cycle regulators) are coded by genes called proto-oncogenes. Proto-oncogenes are normal genes that code for positive cell cycle regulators. Trillions of living cells produce, divide and die in a regulated manner in living organisms. All these events are performed perfectly by the proteins synthesized by proto-oncogenes. Hence, proto-oncogenes are extremely important genes in living cells. However, proto oncogenes can be changed due to mutations resulting in cancerous genes called oncogenes. A change in the DNA sequence of the proto-oncogene results in an oncogene. Oncogenes are encoded for different proteins which are responsible for uncontrollable cell division. The ultimate result of the uncontrolled cell division is the formation of a cancer. The key difference between oncogenes and proto oncogenes is that **oncogenes are mutated or defective versions of proto oncogenes while proto oncogenes are normal genes which regulate cell division of living cells.**

## What are Proto Oncogenes?

Cells undergo division, growth, and death. These cell events are tightly regulated by cell cycle regulator proteins. Cell cycle regulator proteins are coded by genes called proto-oncogenes. Proto-oncogenes are the normal genes which regulate the cell division. They are encoded for all these positive cell cycle regulator proteins essential for normal cell division.

Cell cycle regulator proteins perform many functions such as stimulation of cell division, prevention of cell differentiation or regulation of programmed cell death (apoptosis), etc. Research carried out on proto-oncogenes of humans revealed that there are more than 40 different proto-oncogenes in humans.

The DNA sequence of the proto-oncogenes can change due to [mutations](#). When proto-oncogenes are mutated, the mutated or defective genes are called oncogenes.

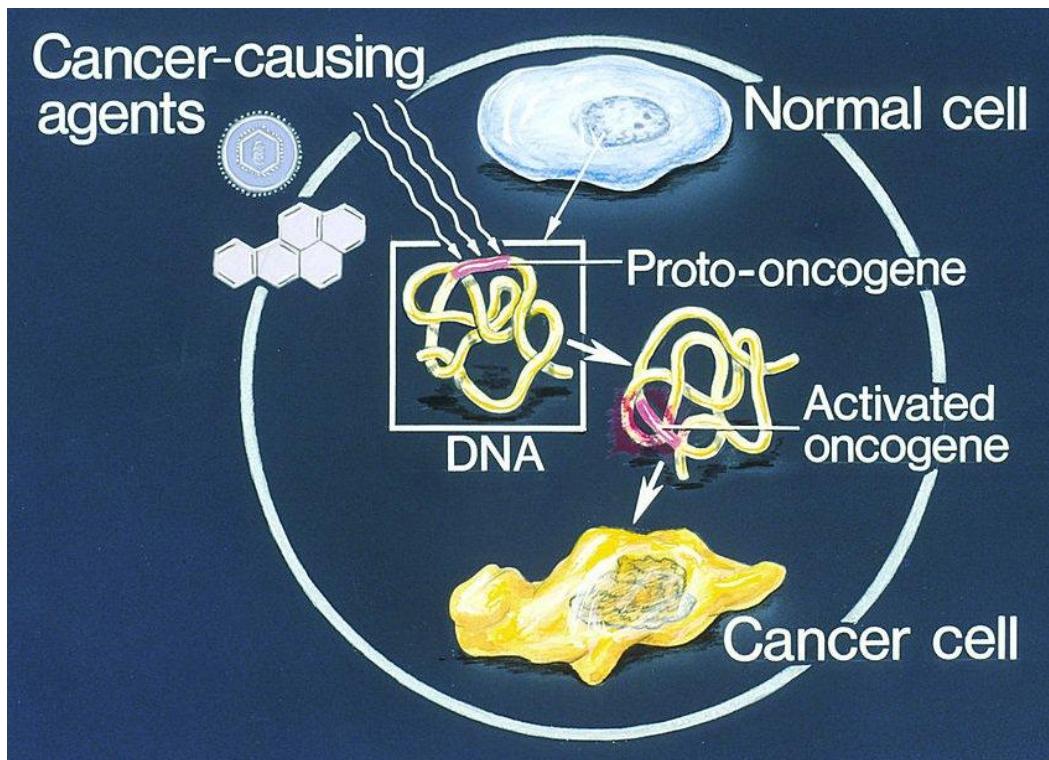


Figure 01: Conversion of proto-oncogenes into oncogenes

The mutated proto-oncogenes produce different proteins which cause uncontrolled cell divisions. The uncontrolled cell divisions cause the formation of cancers or tumors.

## What are Oncogenes?

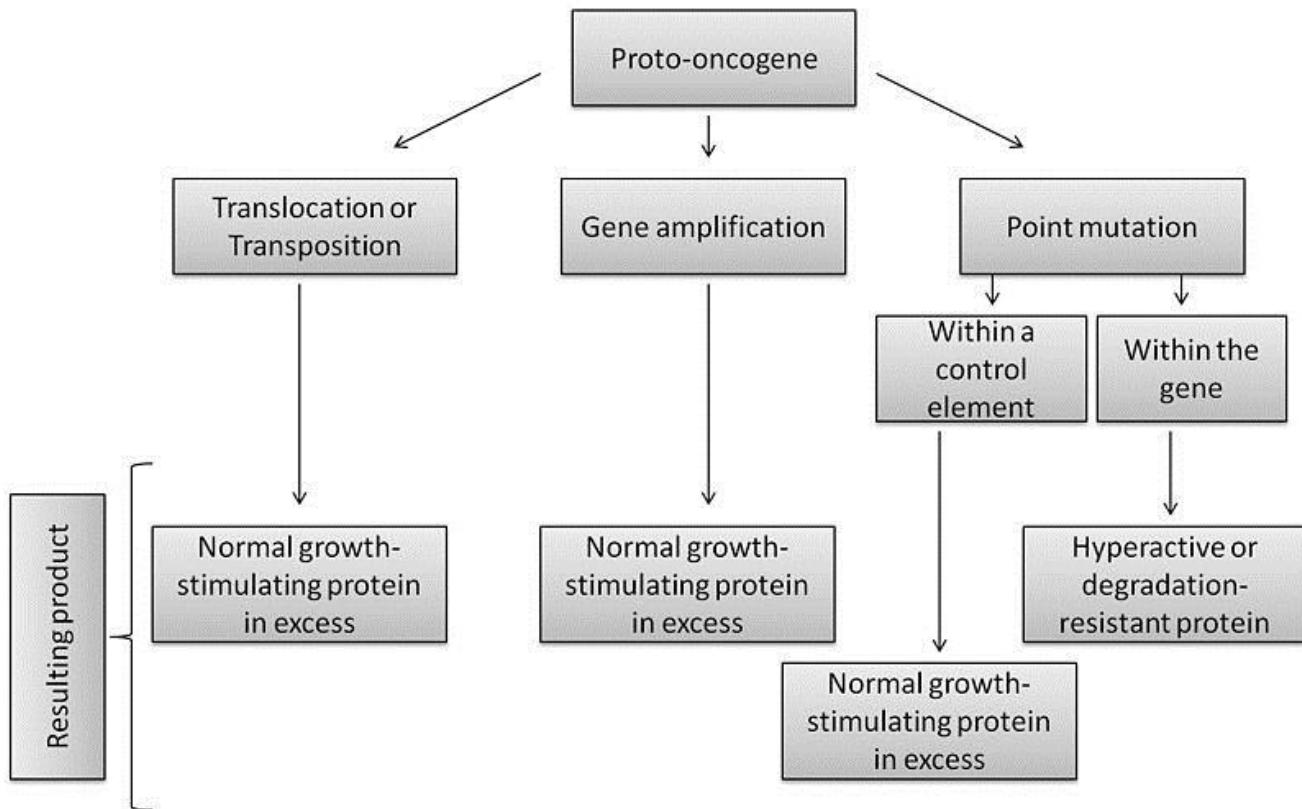
As mentioned above, oncogenes are genes which cause cancers. In other words, oncogenes can be defined as cancerous genes. Oncogenes are mutated proto-oncogenes. When the DNA sequence of the proto-oncogene is changed or mutated, it results in an oncogene. Oncogene is coded with different proteins which influence normal cell cycle. Oncogenes produce inhibitors of the cell cycle which are capable of continuing cell division even during conditions that are not good for cell division. Oncogenes also produce positive regulators which are capable of keeping cells active till the formation of a cancer. Oncogenes work towards cancer

formation by promoting uncontrolled cell division, lowering cell differentiation and inhibiting normal cell death (apoptosis).

Proto-oncogenes become oncogenes due to several genetic modifications or mechanisms such as mutations, gene amplifications, chromosomal translocations. They are listed out as follows.

1. Production of overactive gene products by point mutations, insertions or deletions.
2. Increased transcription by point mutations, insertions or deletions
3. Production of additional copies of proto-oncogenes by gene amplification
4. Movement of proto-oncogenes into different chromosomal site and cause for increased expression
5. Fusion of proto-oncogenes with other genes which can cause oncogenic activity

#### Mutations that can Lead to a Proto-oncogene becoming a Cancer Causing Oncogene:



Proto-oncogenes of people have a higher tendency to convert into oncogenes and develop into cancers due to various cancer causing agents such as radiation, viruses, and environmental toxins.

## What are the similarities between Oncogenes and Proto Oncogenes?

- Oncogenes and Proto Oncogenes are genes related to cell division.
- Both are made up of DNA sequences.
- Both encode for proteins.

## What is the relationship between Oncogenes and Proto Oncogenes?

- Proto-oncogenes become oncogenes by several genetic mechanisms. Hence, oncogenes are the mutated or defective proto-oncogenes.

## What is the difference between Oncogenes and Proto Oncogenes?

Oncogenes vs Proto Oncogenes	
Oncogenes are mutated or defective genes.	Proto-oncogenes are normal genes.
Cancerous Nature	
Oncogenes cause cancers.	Proto-oncogenes do not cause cancers.
Coding	
Oncogenes are coded for different proteins which change the normal cell cycle leading to uncontrolled cell division.	Proto-oncogenes are coded for normal cell cycle regulator proteins.
Relationship with Cell Cycle	
Oncogenes negatively regulate the cell cycle.	Proto-oncogenes positively regulate

the cell cycle.

## Summary – Oncogenes and Proto Oncogenes

Proto-oncogenes are normal genes that regulate cell division and cell cycles. These genes encode for cell cycle regulator proteins. DNA sequences of proto-oncogenes can be mutated and converted into cancerous genes called oncogenes. Oncogenes are mutated or defective proto-oncogenes which produce different proteins which promote uncontrolled cell division and cancer formation. This is the difference between oncogenes and proto-oncogenes.

### Image Courtesy:

1. "Conversion of proto-oncogene flow chart" By Haywardlc – Own work (CC0) via [Commons Wikimedia](#)
2. "Oncogenes illustration" By National Cancer Institute, an agency part of the National Institutes of Health (Public Domain) via [Commons Wikimedia](#)

### References:

1. Robertson, Sally. "What are Proto-Oncogenes?" News-Medical.net. N.p., 22 Dec. 2014. Web. [Available here](#). 05 July 2017.
2. Pierotti, Marco A. "Mechanisms of oncogene activation." Holland-Frei Cancer Medicine. 6th edition. U.S. National Library of Medicine, 01 Jan. 1970. Web. [Available here](#). 06 July 2017.

### How to Cite this Article?

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