



Gene  
Carcinogen

# Jesuit Centre

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## Chromosome Aberrations

Inside every living cell there are long molecules called chromosomes which contain the genes. Genes are coded sequences of chemicals which act like a template, controlling the production of enzymes, hormones or other substances needed by the body. If these genes are damaged, the substance which they produce will be changed. If a large number of genes are damaged, or if a few are damaged and these keep on producing cells which contain copies of their own damaged genes, this may be experienced by the person as some form of disease or illness. For example, the person may become unable to digest certain foods, may be unable to produce antibodies which would ward off particular diseases, or may develop hormonal diseases such as diabetes or hypothyroidism. Gene damage can occur gradually over a lifetime, being experienced as "aging", or it can happen suddenly because of exposure to radiation and/or toxic chemicals.

Genes are too small to be seen under most microscopes. However, the chromosomes, long strings of genes, can be seen rather easily. If chromosome damage is found, one can be relatively sure that some external agent has harmed the cells. One can also assume that there has been damage to the genes, especially those in the region of the break.

When a person is exposed to ionizing radiation, there will always be some damage proportional to the radiation dose. Severe damage to the genes often leaves the cell unable to reproduce itself. These cells die and are eventually eliminated from the body. Some cell damage can be repaired, and the cell's reproductive capacity restored. However, when there are a large number of such repairs, the probability of mistakes in repair increases.

The chromosome aberration test is a count of the number of visibly damaged chromosomes per hundred metaphases, i.e., cells in the process of dividing. This count would diminish as the time between examination and exposure to the radiation and/or chemical toxic agent increases, since cells too damaged to be able to reproduce themselves would, over time, die and be eliminated. The human body is able to repair some damage to genes. In so doing it sometimes re-connects parts of chromosomes erroneously. This misrepair can be detected by the sister chromatid exchange (SCE) test. The SCE test would detect damage for a longer period of time after the original exposure, since misrepaired cells could continue copying the misrepair. Both tests give a gauge of the number of "errors" in the body's delicate regulatory system, but they do not indicate exactly what the result of errors will be. Current research effort is attempting to make such practical connections, but the conclusions are now limited to only a few clear connections between chromosome damage and defined illness.

Chromosome tests are usually performed on blood. Circulating blood cells, produced by bone marrow, are reflective of the damage which has been done to the bone marrow and of the state of recovery of this important tissue. The bone marrow tissue and skin can also be tested for chromosome damage. In deciding on tests needed, it is important to consider the supposed damaging exposure and the organ or tissue it most likely affected.

How to interpret a blood chromosome test:

1. If chromosome aberrations and sister chromatid exchanges are within the normal range, your body is now producing visibly normal cells. You may have some gene damage which is not visible, and/or you may have had more severe aberrations in the past. The probability that you can physically cope and can improve your health is good.
2. If chromosome aberrations and sister chromatid exchanges are high normal or above normal, you should report this to your doctor and take more than usual pains to give yourself rest, nourishment and a chance to physically recover. High abnormality rates may indicate a susceptibility to cancer, so it would be well to be more aware of this and to seek medical care if you are conscious of any symptoms. Developing cancer (or other health-threatening diseases) is not automatic, though, and many people with abnormal chromosomes lead a very normal life with no severe medical problems.
3. If your chromosome aberration count is abnormal and you wish to have children, it may help to wait until your body has a chance to fully recover. Badly damaged sperm will not be able to fertilize an ovum, or the fetus may not survive to birth. This is nature's way of eliminating the most severe effects.
4. If you have a child who has severe health problems, you may wonder if it is related to your exposure. You should realize that the body system that produces blood is not the same as that which produces the sperm or ovum (egg). It is possible to damage one system without damaging the other. Damage to your reproductive system could cause damage to one or more systems in the child. This may or may not include the child's blood-forming system (thus blood chromosome testing on the child may or may not show damage). If the child shows high blood chromosome damage with no apparent cause, it might well be associated with the parents' damaged sperm or ovum.

If your test indicated a high normal or above normal of chromosome problems, you should have another test in 6 months to a year's time. Your cooperation with researchers is helping to build a pool of human experience which will better enable doctors to answer questions in the future. If you have further questions on this, please feel free to get in touch with us.

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