

CHROMOSOME REARRANGEMENTS DISCOVERED THROUGH PRENATAL DIAGNOSIS



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Introduction

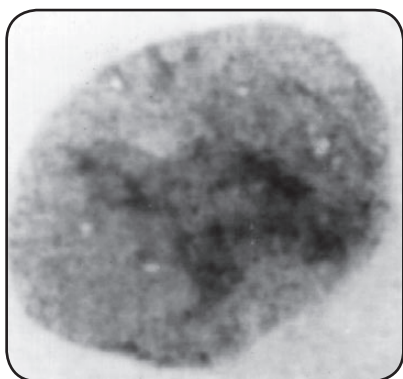
The purpose of this booklet is to provide families with information about unusual results from prenatal testing. This can be a very anxious time for many families and, often, there is little information available to people outside the genetics field. This booklet is designed to provide you with some information, but it may not answer all of your questions.

Please talk to a genetic counselor or a medical geneticist for specific information about your situation. They are there to help. This booklet may also help you explain test results to your family and health care providers.

I. Cells

The testing which was performed on your fetus (unborn baby) was done by examining cells from either the amniotic fluid (amniocentesis) or the afterbirth/placenta (chorionic villus sampling). In both cases, the cells came from the same fertilized egg as the fetus. When the cells were examined, the packages of genetic material or information, called chromosomes, were examined. Each cell in both the baby's body and in your body contains a complete set of chromosomes.

Your baby's body is made up of many billions of cells. This is a picture of a cell. They are so small they can only be seen by using a microscope:

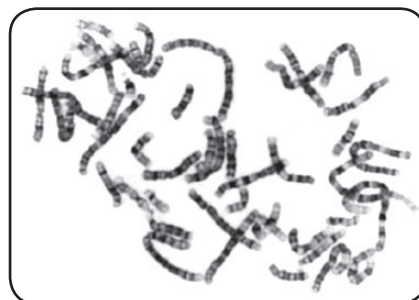


II. Chromosomes

When cells are grown and processed in the laboratory, chromosomes can be studied. There are usually 46 chromosomes in each cell. The chromosomes are like a huge set of cookbooks. Each chromosome contains thousands of recipes which are pieces of information or instructions. These instructions or recipes are called "genes." Therefore, the chromosomes are packages of genes which direct the body's development. For instance, there are genes which tell whether a person will have blue eyes or brown eyes, brown hair or blonde. All the information that the body needs to work comes from the chromosomes. The chromosomes contain the blueprint for growth and development. Scattered over the 23 pairs of chromosomes are about 25,000-35,000 genes.

A very small piece of a chromosome can contain many different genes. The precise location or even the number of all the genes is not known. Chromosome studies do not include a detailed examination of each gene.

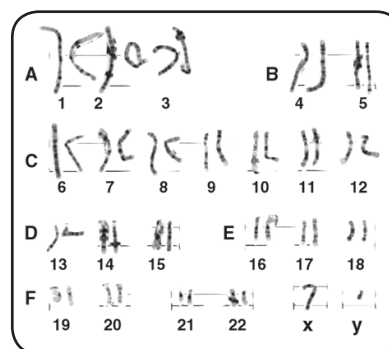
Chromosomes come in pairs. One member of each pair comes from the father's sperm cell and the other member of the pair comes from the mother's egg cell. In other words, the baby receives half of its genetic material from the mother and half from the father.



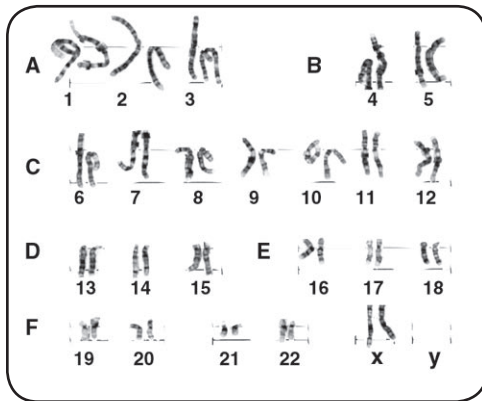
III. The Karyotype

In order to examine these chromosomes carefully, the laboratory photographs them, cuts them out, and prepares a picture of them by pairing the chromosomes and lining them up in order of their size and their characteristic light and dark banding patterns. The sex chromosomes are usually placed alongside the other chromosomes. An X and a Y chromosome indicate a boy and two X chromosomes indicate a girl. This picture is called a karyotype.

This is a picture of a normal male karyotype:



This is a picture of a normal female karyotype:



IV. Unusual Chromosomes

Although most people have chromosomes which look like these photographs, there are some people who have chromosomes which are different.

The vast majority of people with unusual chromosomes are normal, healthy, and intelligent.

As long as all the chromosomes and genes are present, and there is no extra or missing chromosome material, there are usually no problems related to unusual chromosomes.

Often, unusual chromosomes are passed along through many generations in a family before they are discovered. Sometimes the discovery is made as a result of amniocentesis or chorionic villus sampling, when a baby's cells are examined. Sometimes it is discovered when a couple has problems becoming pregnant or when a baby is born with problems.

Prenatal testing is most often performed to tell if a fetus (unborn baby) has any extra or missing chromosomes. For example, babies with Down syndrome (trisomy 21, formerly known as "mongolism") have an extra chromosome 21.

However, since all the chromosomes are examined in the lab, sometimes changes in other chromosomes are found. This booklet contains

information about some of the more common chromosome changes which may occur.

It may be helpful to skip ahead in this booklet to the type of chromosome change found in your pregnancy.

V. Inversions

An inversion occurs when a chromosome breaks in two places, and the piece between the breaks turns upside down and reattaches in the same chromosome.

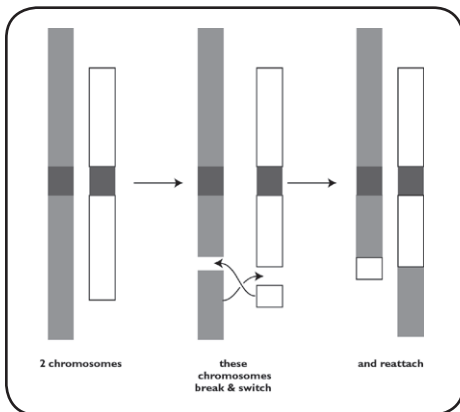
Some inversions are so common in the population that no further testing is needed. Whenever a less common inversion is found in a fetus, the parents' chromosomes are then studied. This is done by drawing blood from both parents, processing their cells in the laboratory, and examining the chromosomes under the microscope. The additional tests are usually completed within one to two weeks.

If one parent has the same inversion as the fetus, there are usually no problems. The parent's normal development proves there were no genes harmed when the chromosome broke and reattached. However, if neither parent has the inversion, then there is a chance that some of the instructions on the chromosome were changed. This is similar to moving a recipe from one chapter in a cookbook into another chapter. If the recipe was moved with all the ingredients and instructions, the recipe should be fine. This is usually what happens. However, if some of the instructions were lost or changed, there may be problems, including birth defects and delays in development. Since it is not possible to look at the gene level to determine if a gene is missing or changed, there is no guarantee that your baby or any other baby will be normal. This is true even if the chromosomes are completely normal. An inversion:

VI. Translocations

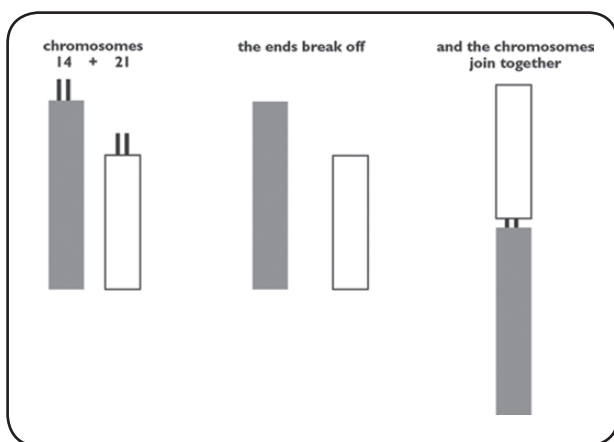
A translocation occurs when the location of specific chromosome material changes. There are two common types of translocations. In **reciprocal translocations**, two different chromosomes have broken, exchanged pieces of chromosome material and reattached. This is an example:

A Reciprocal Translocation:



Another type of translocation involves certain whole chromosomes which attach to each other at a special location called the centromere. This is called a **Robertsonian translocation** and here is an example:

A Robertsonian Translocation:



Whenever a translocation is found in a fetus, the parents' chromosomes are then studied. This is done by drawing blood from both parents, growing their cells in the laboratory,

and examining the chromosomes under the microscope. The additional tests are usually completed within one to two weeks.

If one parent has the same translocation as the fetus, there are usually no problems. The parent's normal development demonstrates there were no genes harmed when the chromosomes exchanged material. If neither parent has the translocation, there is a chance that some of the instructions on the chromosomes were changed in the process of rearrangement. This is similar to moving a recipe from one cookbook into another cookbook. If the recipe was moved with all the ingredients and instructions, the recipe should be fine. However, if some of the instructions were lost, there may be problems. Since it is not possible to look at the gene level to determine if a gene is missing or changed, there is no guarantee that your baby or any other baby will be normal. This is true even if the baby has normal chromosomes.

VII. Markers

A marker chromosome is a piece of chromosome material. It is called a marker because it is not clear from which chromosome (or chromosomes) it came. Usually when a marker is present, it is an extra chromosome.

Depending on what genes are carried on this chromosome, there may or may not be related health problems. Although it is usually not possible to tell what genes are carried on the marker, sometimes the laboratory can tell what kind of genetic information is located on the marker chromosome. The laboratory may be able to identify the origin of the marker chromosome through additional special chromosome stains. Knowing the chromosome of origin may be helpful in making predictions about the health of your baby.

In addition to all the genes that direct important body functions, everyone has a lot of genetic material that is normally silent. Extra or missing pieces of this silent material do not cause

problems. Extra or missing pieces of the active genetic instructions, however, usually have some effect on the baby.

Sometimes, the marker is found in all the cells in the baby's body. But sometimes there is a mixture of cells, some with the marker and some without. There may be a different effect depending on how many and which of the baby's cells carry the marker chromosome.

Whenever a marker is found, the parents' chromosomes are then studied. This is done by drawing blood from the parents, processing their cells in the laboratory, and examining the chromosomes under the microscope. The additional tests are usually completed within one to two weeks.

If one parent has the same marker as the fetus does, there are usually no problems. The parent's normal development suggests that the extra genetic material is silent. If neither parent has the marker, then there is a chance that there is some extra active genetic information present. This is similar to adding extra salt to a cake recipe. An extra cup of salt will change how the cake tastes. An extra pinch of salt would make very little difference. Since it is not possible to look at the gene level and determine if a gene is missing or changed or added, there is no guarantee that your baby or any other baby will be normal.

VIII. What happens if an unusual chromosome has been inherited from a healthy parent?

As mentioned above, when unusual chromosomes are inherited from a parent, the rearrangement is considered "balanced," and there are usually no resulting health problems in the baby.

However, people who have unusual chromosomes may have reproductive problems as a result of the rearrangement. This may be true for both the parent who has the unusual chromosomes and for the baby when he or she grows up. People who have balanced rearrangements are usually able to have healthy children. However, unusual chromosomes can lead to problems such as infertility (difficulty in becoming pregnant), miscarriage, or the birth of a child with a serious birth defect and/or mental retardation. This occurs because the fetus may inherit too much or too little chromosome material as a result of the unusual chromosomes.

When a parent is found to have unusual chromosomes, an additional concern is raised. That parent's other relatives may also have inherited the same unusual chromosomes and have the same risks for having reproductive problems.

For these reasons, it is highly recommended that you share the information in this booklet with other family members. Some relatives should have the option to have their chromosomes studied, too. We encourage genetic counseling for all relatives who are concerned about chromosome rearrangements in the family, and we are here to help answer any questions.

IX. What if the parents have normal chromosomes?

For every family with a chromosome rearrangement, there was always a first person with the rearrangement. The first person in your family may be your baby. These unusual chromosomes may not cause any problems in your baby's growth and development. But, there is a chance that they will. Your physician or genetic counselor may suggest additional studies of your fetus to identify any possible problems. They may suggest a detailed ultrasound and an echocardiogram (a detailed ultrasound examination of the baby's heart). Since it is not possible to identify all birth defects before a baby is born, there will still be a risk for

problems even if all the studies are normal. This is true even when all the chromosomes line up in the usual way.

For some people, the additional risk for problems in the fetus is too high and they choose to end the pregnancy. Others choose to continue the pregnancy, especially if they feel it is more likely that the baby will be normal. This is a very difficult and personal decision and it may take time to make. Each family must weigh their own feelings, along with the risks.

Your genetic counselor or physician is available to help you make the best decision for your family. Let them know how they can help.

Notes

In the Pacific Northwest

There are genetics clinics and prenatal diagnosis clinics in Alaska, Idaho, Oregon, and Washington.

Anyone can call for more information...
To find the clinic nearest you call:

Alaska: 907-269-3430

Idaho: 208-334-2235 x258

Oregon: 971-673-0272

Washington: 253-395-6743

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