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Association of Gene Mapping

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Gene mapping refers to the mapping of genes to specific locations on chromosomes. It is a critical step in the understanding of genetic diseases. There are two types of gene mapping:

- **Genetic Mapping –** using linkage analysis to determine the relative position between two genes on a chromosome.
- **Physical Mapping –** using all available techniques or information to determine the absolute position of a gene on a chromosome.

✓ Genetic Mapping

- Requires informative markers – polymorphic and a population with known relationships.
- Best if measured between "close" markers.

Unit – **centiMorgans, cM (1cM = 1% chance of recombination between markers)**

✓ Physical Mapping

- Relies upon observable experimental outcomes
- Hybridization
- Amplification

(May or may not have a distance measure.)

Techniques

- **In situ Hybridization:** The method which involves hybridizing labelled DNA/RNA probes directly to metaphase chromosomes.
- **Somatic Cell Hybridization:** The method which to fuse somatic cells from different species.

a) Based on segregation technique
b) To difference between species

- **Gene dosage using patient cells :** The method which to detect dosage differences in either 'gene products or gene sequences themselves between patients' cell lines containing different numbers of copies of a particular gene.
- **Dosage Effect:** originally used to assign genes to chromosome to detect levels of enzyme activity in cell lines from patients. At the DNA level, the dosage approach has been used increasingly to assign DNA markers to the X chromosome.
- **Chromosomal Aberration:** To detect directly chromosomal aberration involving genes which may lead to particular disease.
- **Linkage Analysis:** It is a method of mapping genes that uses famiy studies to determine whether two genes show linkage when passed on from one generation to the next. Mapping by genetic linkage analysis differs from mapping by physical methods because

physical mapping relies on having a laboratory method to localize a gene by FISH or by somatic cell hybridization.

In contrast, linkage analysis is a tremendously important and powerful approach in medical genetics because **it is the only method that allows mapping of genes, including disease genes that are detectable only as phenotypic traits.**

Methods	Known Gene	Known Proteins	Disease Gene
In situ hybridization	+	-	-
Somatic cell hybridization	+	+	-
Dosage effect	+	+	-
Chromosome aberration	-	-	+
Linkage analysis	+	+	+

Conclusion

The ultimate goal of gene mapping is to clone genes, especially disease genes. Once a gene is cloned, we can determine its DNA sequence and study its protein product. In 1985, the gene was mapped to chromosome 7q31q32 by linkage analysis. Four years later, it was cloned by Francis Collins and his co-workers. We now know that the disease is caused by the defect of a chloride channel – the protein product of this disease gene.

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