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THE EDITOR'S CORNER

Nature or Nurture

The announcement this month of the successful mapping of 90% of the human genome signals the most significant breakthrough in the history of biology and, indeed, in the history of humanity. The implications for the prevention and correction of human diseases and malformations are staggering. Nevertheless, it is bound to take many more years for scientists to conclude what each gene does and, more important, how it does it. Humans look like humans and canaries look like canaries, but it is not too helpful to say merely that the difference depends on heredity. We are on the verge of knowing not only *what* the differences are, but *why* they are.

The question of nature vs. nurture—of how much each influences the development and functioning of every living thing—is still with us, and will be with us long after the mapping of the human genome and other genomes has been completed. It is a seminal question in the study of human growth and development and in the etiology of malocclusion. At present, we are better acquainted with postnatal environmental effects than we are with hereditary contributions to malocclusion. A simple example might be the premature loss of a tooth or teeth and the subsequent disarrangements of the remaining teeth. I say "might be" because there is likely a heritable link controlling the movements that produce malocclusion, even in this seemingly direct cause-and-effect relationship. It is safe to say that heredity—the genes—is basic to ontogeny and, quite likely, to every post-ontogenetic event.

Orthodontic research into the relationship of heredity and malocclusion to date has largely been based on twin studies. From these, on a statistical basis, the researchers derived what they deemed to be the relative importance of heredity and environment in certain skeletal and dental relationships. These were inferential results, without much relationship to actual genes. They also had the drawback, perhaps unavoidably, of being group studies. Future understanding of hereditary influences on malocclusion will be based on studies of indi-

vidual patients' genomes. We know that each individual's genome is unique; in fact, its uniqueness has famously been used to disprove guilt in paternity cases. It is pertinent to note here that the human genome published as a result of the mapping process is not *the* genome. It is either a consensus genome, on the government side, or the genome of one individual, in the competing commercial model.

A certain amount is already known about the genetic defects that cause a few of the debilitating or deadly human conditions. It remains to be known, first of all, what the effects of genetic redesign might be, without necessarily having solved the intricate mechanism of how it works. Later on will come an unfolding of the process and possibilities of other chemical, mechanical, or electrical changes that will treat genetic disorders in more sophisticated ways.

Much of the genetic chemistry at the molecular level is so complex that it will be some time after the complete genome has been mapped before we solve the mystery. Still, the future holds the possibility of making alterations in the genome to prevent, cure, or ameliorate diseases and malformations. A few such conditions are caused by a single defective gene, and manipulating that gene at the egg stage could conceivably correct the defect and avoid the condition. More often, the process is more complicated, involving a number of genes. For orthodontists, genetic manipulation might begin with avoiding congenitally missing teeth, proceed to guiding tooth development and eruption patterns, and end up controlling the interactions among bone, nerve, and muscle in the process of growth and development.

Of the long list of diseases and deformities that afflict humans, it seems certain that life-threatening conditions will go to the head of the line in genetic research. Next might come chronic diseases, such as arthritis, then less serious conditions that afflict most people, such as the common cold. Next might come quality-of-life-threatening disorders. A certain number of these relate to growth and development, and genetic knowledge gleaned in this field will spill over into orthodontics. But each area of growth, while sharing some genetic material, is unique in many ways and will need to be studied specifically. Because orthodontics may not rank high on the list, it is unlikely that we will soon see the unraveling of the true etiology of malocclusion. Perhaps some orthodontic researchers will decide to specialize in genetic research.

It seems clear that knowledge of the individual's genome will eventually lead orthodontists to abandon their reliance on group norms and classifications. Knowledge at the molecular level will uncover how each individual grows and develops, and may ultimately point to the one best way to treat that individual. ELG