Epigenetic orthodontics: facial and airway development

Article *in* The New York state dental journal · November 2010

Source: PubMed

1 author:

Theodore R Belfor

6 PUBLICATIONS **11** CITATIONS

SEE PROFILE

Read, Learn and Earn
CE
CONTINUING EDUCATION

Epigenetic Orthodontics

Facial and Airway Development

Theodore R. Belfor, D.D.S.

Abstract

It is the purpose of this article to introduce a functional orthopedic/orthodontic appliance, the Homeoblock™ (Figure 1), which, when worn at night (3 p.m. to 8 a.m.), alters oral function and produces a gene environmental interaction that results in an epigenetic response, namely, the expression of unexpressed genes in adult patients. The results of the case studies presented are evaluated using state-of-the-art, three-dimensional technologies: cone beam computerized tomography combined with Dolphin and Analyze 10.0 software (Mayo Clinic). The results, in so-called non-growing adult patients, can only be attributed to gene expression.

MOST PEOPLE have a basic idea of the meaning of genetics. For example, they know that hair and eye color can be directly related to what is in our DNA, found in the genes inherited from our parents.

The Human Genome Project, completed in April 2003, managed to map or sequence the 20,000 to 25,000 genes that make up the human genome.[1] Scientists were excited by the prospect of possibly curing some of the 4,000 gene-related diseases.[2] Here we are seven years later without so much as a cure for any gene-related disease.

Knowing what the genes are and how they affect us is only part of the story. Turning genes on and off is, possibly, the most important second act. The chemical modifications of genes that are heritable from one generation to the next and affect gene expression but do not alter the DNA sequence comprise the second act. The study of these chemical modifications—what they are, how they are laid down and the processes they control—is the field of research known as epigenetics.

Melvin Moss published The Functional Matrix Hypothesis Revisited. 1. The Role of Mechanotransduction in July 1997. He showed us how the introduction of mechanical forces, such as forces applied to teeth, can result in bone morphogenesis and tooth movement, as well as craniofacial changes through genetic environmental interaction.[3] In September 1997, he published The Functional Matrix Hypothesis Revisited 3. The Genomic Thesis and introduced epigenetics into his equation.[4]

Epigenetics can no longer be overlooked. The new Human Epigenome Project (HEP) began in 2003. The Human Genome Project provided the blueprint for life, but the epigenome will tell us how the whole thing gets executed. It might be the most exciting research of the 21st century.

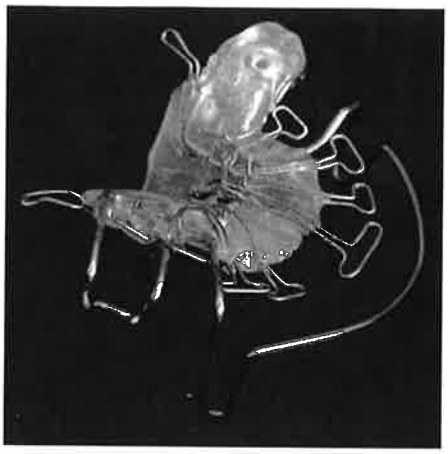


Figure 1. The Homeoblock.

Case Study One

An adult female patient with a chief complaint of head and neck pain and facial asymmetry was referred to us. A CBCT scan and facial photos were taken to establish baseline records. Upper and lower dental models were also taken, and upper and lower Homeoblock appliances were fabricated. She was started with the upper appliance only for six months.

The Homeoblock consists of "Adams clasps" on the bicuspids, with a base plate that incorporates a palatal expansion jack screw. The appliance is relieved from the palatal tissues. Flap springs rest on the anterior teeth and a Hawley arch wire extends from canine to canine. A bite block is placed on the second bicuspid, on the less developed side. Bird beak pliers and/or three-prong pliers are used for adjusting the clasps.

The patient wore the Homeoblock appliance at night only. Facial photos were taken every three months (Figure 2). A second CBCT scan was taken after six months and evaluated using Analyze 9.0 developed by the Mayo Clinic for registering and evaluating changes in bone (Figure 3). Intraoral photos of the appliance in place were taken each month (Figure 4). Her airway was evaluated after six months (Figure 5).

Case Study Two

An adult male patient suffering from severe sleep apnea presented for treatment advice. The patient had been treated successfully with continuous positive air pressure therapy (CPAP) and unsuccessfully with a mandibular advancement device. He viewed this new treatment as a last resort, since it was his desire not to wear a CPAP for the rest of his life. He was told that this might be possible through craniofacial development or surgery.

A CBCT scan was taken to establish baseline records; upper and lower dental models were also taken. Upper and lower Homeoblock appliances were fabricated. The patient wore the appliance at night only, along with the CPAP device. After six months, his anecdotal results were encouraging. He reported that,

Figure 2 A. Note: Enhanced facial symmetry.

Figure 2 B. Note: Opening of right nostril.

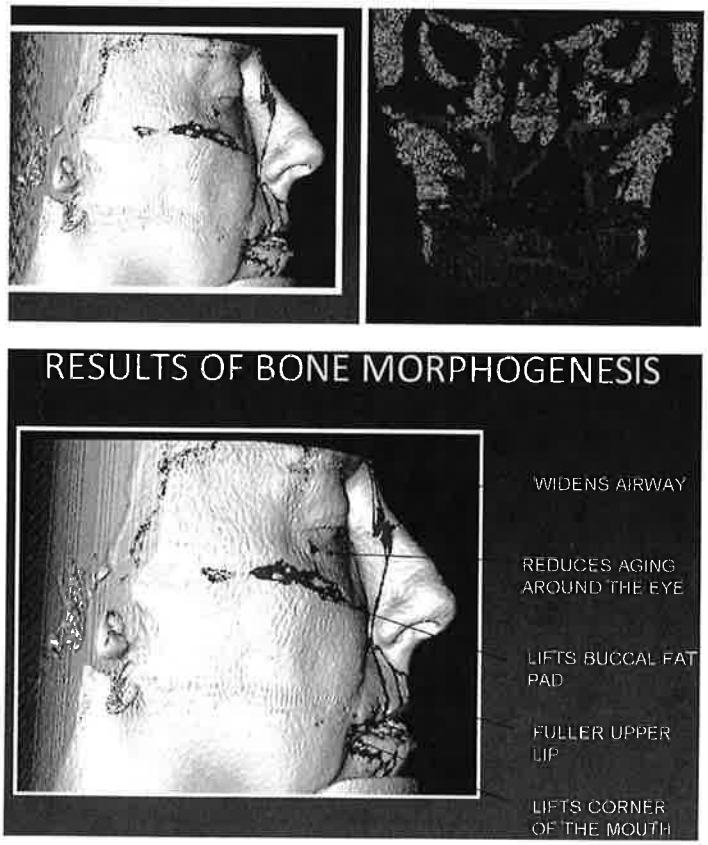
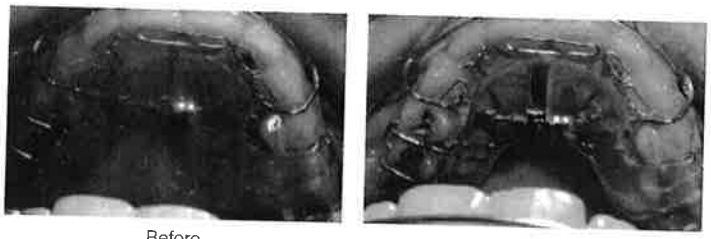


Figure 3. Analyze 9.0 software using DICOM data and registering bone after six months' treatment shows enhanced bone volume in red.



Before After

Figure 4. After 10 months' treatment alveolus remodels wider.

Figure 5. Before After

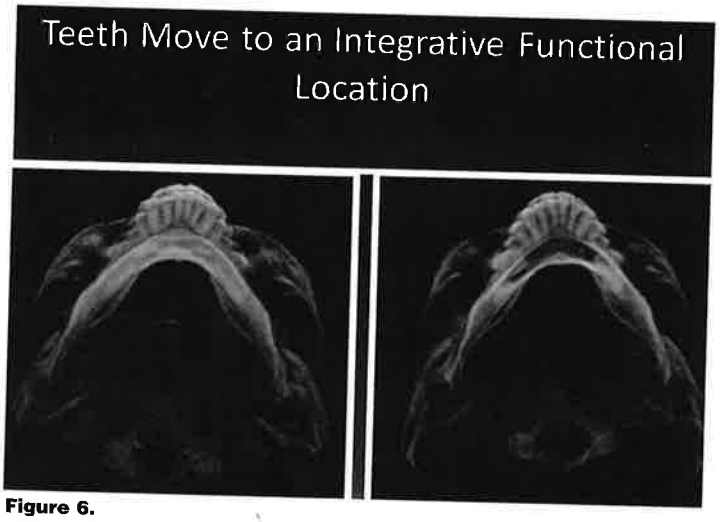
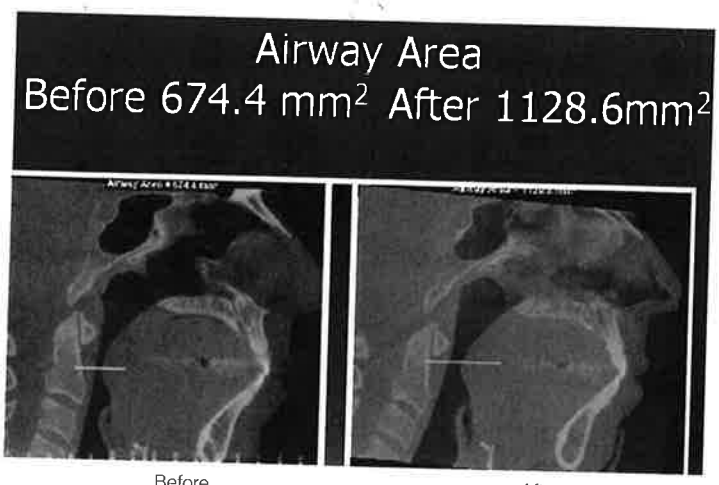


Figure 6.



Before After

Figure 7A. Improved oropharyngeal axial airway area.

on occasion, when he was unable to wear the CPAP and only wore the Homeoblock appliance, he was feeling much better. He described more energy later in the day.

After 12 months, he was tested with a follow-up overnight study without any appliance or CPAP.

Results

Both case studies show improved airway and facial volume. In Case Study One, it is evident that the patient's right nostril has been opened, resulting in easier breathing.

In Case Study Two, the patient was treated for 16 months with the Homeoblock appliance. Since we know that air flow is a factor of the radius of the pharyngeal space to the fourth power, and we have almost doubled the radius (see before and after "Dolphin" evaluation), this means we have increased the patient's air flow considerably. The patient presented with an RDI of 45 and AHI of 28. His post-Homeoblock treatment PSG showed an AHI of 5. This patient maintained a stable BMI. The AHI before and after is based on 4% reduction in oxygen saturation. After further treatment with Provent nasal valve therapy, his AHI was reduced to 1. The patient was cured of his sleep apnea and put his CPAP away.

Discussion

In biology, epigenetics is the study of changes in phenotype (appearance) or gene expression caused by mechanisms other than changes in underlying DNA sequence. Epigenetics is a new science that recognizes what intervenes between genetic expression and phenotype. This includes all extraorganasmal and macroenvironmental factors, for example, food, light, temperature, mechanical loading and electromagnetic fields.

The Human Epigenome Project has been underway since 2003. Melvin Moss, a leading theorist on how bones of the face grow, considers the relative roles of genomic and epigenetic processes and mechanisms in the regulation (control, causation) of craniofacial growth and development. In his article The Epigenetic Antithesis and the Resolving Synthesis, he suggests that both genomic and epigenetic factors are necessary causes; that neither alone is sufficient cause; and that only the two, interacting together, furnish both necessary and sufficient cause(s) of ontogenesis.

Conclusion

Since no gene has ever turned itself on but requires outside epigenetic input, we suggest that altering the oral environment and affecting the swallowing in our adult patients with the Homeoblock appliance is sufficient mechanical epigenetic input to upregulate or turn on genes for craniofacial development that have not yet been expressed. Membranous bone (maxillary) is particularly sensitive to biological stresses and strains. A typical response to tension would be osteoblastic activity and deposition of bone.

When muscle and bone growth is complete, the body attains biological equilibrium and bone growth ceases. Introducing intraoral tension on the palatal and alveolar bone in adults stimulates

Before After

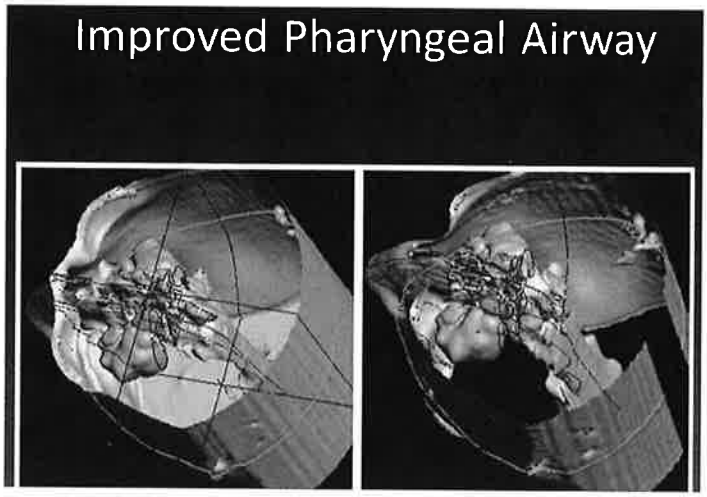
Figure 7B. CBCT analysis with "Dolphin" software.

the re-emergence of osteoblastic activity and bone growth as we have seen in the two case studies presented here.[5] ■

Queries about this article can be sent to Dr. Belfor at Belfor2@MHCable.com.

REFERENCES

1. The National Human Genome Research Institute; National Institutes of Health, Bethesda, MD.
2. American Society of Cell and Gene Therapy; Milwaukee, WI.
3. Moss ML. The functional matrix hypothesis revisited. 1. The role of mechanotransduction. Am J Orthod Dentofacial Orthop 1997 Jul;112(1): 8-11.
4. Moss ML. The functional matrix hypothesis revisited. 3. The epigenetic antithesis and the resolving synthesis. 1997 Sept;112(3):338-42. Review. The genomic thesis.
5. Enlow DH. J. JCO/interviews Dr. Donald H. Enlow on craniofacial growth J Clin Orthod 1983;Oct. 17(10):669-79.



Before After

Figure 8. Improved airway symmetry. Visual evaluation with Analyze 10.0 software. CBCT data and visual evaluation with 3dMDvultus software.

Figure 9. Red area shows increased bone volume over 16 months using Analyze 10.0 software.