Introduction

The hard and soft tissue components of the mammalian craniofacial complex (e.g., bones, teeth, muscles and other soft tissues) dedicated to food processing such as chewing, grinding, tearing, and swallowing are also intimately connected to the hard and soft tissues of the upper respiratory complex through the nose, the sinuses, and pharynx and the larynx. Collectively these two survival apparatuses comprise the Cranio-Facial-Respiratory Complex (CFRC).

Charles Darwin described a theoretical process by which one species could gradually change into another as transmutation. Darwin eventually came to describe this transmutation of species process as ‘Evolution by Natural Selection’ (NS). There are several processes by which these traits evolve, however, the main process of NS requires genotypic diversity such that the various phenotypes present in the population are then subject to ever-changing and challenging environmental conditions. Over time, this process of epigenetic modulation of phenotypic expression can be incorporated into the species’ genome. For instance, the suite of genes responsible for coding various skin-colour phenotypes are thought to be under the influence of NS [Crawford, 2017].

An example of how NS operates on a micro-evolutionary and short-term scale can be made from observations collected during and long after the Dutch Famine or Dutch Hunger Winter, during World War II [Heijmans et al., 2008]. Immediately at the end of WW II the liberated starving Dutch were inundated with massive amounts of highly caloric rescue rations from the Allied Forces. Pregnant women who had survived starvation during this period gave birth to infants who were plagued in adulthood with chronic diseases including obesity, cardiovascular disease, hypertension and type 2 diabetes, collectively termed Metabolic Syndrome. Barker [2007] called this phenomenon the Thrifty Phenotype or Barker’s hypothesis, which suggests that an epigenetic adjustment to fetal ‘energy-substrate utilisation’ genes during famine, conveyed from the environment to the fetus via the placenta, would ultimately confer post-natal survival advantage through promoting excessive storage of energy (fat).

Myofunctional therapy. Part 1: Culture, industrialisation and the shrinking human face

Abstract

Culture, industrialisation and the shrinking human face: Why is it important?

Over the past 300,000 years, not only has the way we consume food from birth through our lifetime changed, there have also been changes related to the methods of food preparation, availability, processing, and storage. These diet-related factors, along with other epigenetic factors, have led to a widespread increase in orofacial myofunctional disorders (OMDs) and resultant human malocclusion phenotypes (HMPs) worldwide. Currently there is an increasing need for resolution of HMPs in early childhood and associated OMDs. This review will include reports of cases and describe the nature of the problem and strategies for effective solutions.

KEYWORDS Diet, Weaning, Malocclusion, Prevention, Orofacial myofunctional disorders, Early orthodontic treatment, Darwinian dentistry, Craniofacial complex, Breathing.

Dentofacial volumetric decreases and industrialisation

Human skeletal malocclusion (HSM) is a nearly ubiquitous finding in populations exposed to environmental factors and cultural practices associated with industrialisation [Saccomanno, 2020]. These HSM phenotypes are a relatively recent phenomenon and only show up rarely in the human fossil and ancient skeletal records [Gilbert , 2001]. Coinciding with women beginning to enter the industrialized workforce during the 18th and 19th centuries there has been an increased prevalence of marked changes in HSM phenotypes, going from hundreds of generations practicing ancestral regimens of infant and early childhood breastfeeding and weaning with minimally processed firm foods, to more modern eating patterns (i.e., bottle feeding and weaning with highly processed ‘baby foods’).

Studies evaluating the consistency of foods in human development and animal models indicate that dietary toughness has a direct impact on the size, shape, and alignment of the masticatory craniofacial bones and teeth [Beecher and Corruccini, 1981; Corruccini and Beecher, 1982; Ciochon et al., 1997; Liu et al., 1998; Lieberman et al., 2004].
The overall cranial length was shorter and the facial prognathism truncated with decreased size in the maxilla and mandible as well, as smaller muscle attachment areas for the temporalis and masseter muscles [Ciochon et al., 1997]. Furthermore, the development of the muscles and masticatory function including suckling was inhibited by weaning onto a liquid diet [Liu et al., 1998], showing that a significantly soft diet can have cascading effects of decreased functionality and growth of the masticatory apparatus. A tougher diet can enable increased ability and efficiency in the chewing motion and bite force, whereas a softer diet does not promote this training of the functional capabilities of the masticatory apparatus [Le Reverend et al., 2014]. Finally, with increased strains from chewing tougher foods, there is a stronger covariation between the dental arch and the temporalis and masseter muscles, whereas a lower strain shows no significant covariation relationship [Noback and Harvati, 2015]. Thus, tougher diets promote growth and development of the masticatory apparatus, a tighter relationship between the functional elements, and an increased efficiency and training of the mouth functions (Fig. 1).

Industrialisation did not affect all countries equally, as food availability, production and consumption depend on cultural norms and traditions. Moreover, industrialisation contributed heavily in the softening of the diet from weaning to old age, in some countries more than others.

Several studies worldwide have shown this relationship between softer diets and phenotypic changes, and that phenotypic changes to the masticatory apparatus can occur within one generation due to a dramatic transition in the diet and food processing strategies where there was a transition from traditional meals prepared with basic processing and cooking methods to the modern diet denoted by mechanized processing [Corruccini, 1999; Little et al., 2006; Defraia et al., 2006]. However, morpho-functional patterns established during development can be modified more easily prior to complete ossification, suggesting that the ideal treatment time for dysfunctions of the masticatory apparatus - due to environmental changes from bottle-feeding, weaning onto soft foods, and a dietary regimen of ‘Westernised’ foods - ought to be prior to the completion of dental and skeletal development [Corruccini, 1999; Cornette et al., 2015].

Human skeletal malocclusion (HSM) can be/become comorbid with many systemic health conditions, such as habitual mouth breathing, sleep-related breathing disorders (SRBD) or obstructive sleep apnoea (OSA) [Boyd, 2020] and is often associated with neurological deficits like Attention Deficit/Hyperactivity Disorder (ADHD), appetite dysregulation and impaired cardio-respiratory fitness (CRF). Therefore, identifying and treating HSM in early childhood takes on additional significance [Paglia, 2019].

**Case reports**

Here are described the following case reports.

1. A single case study of a 4-year-old child born and being raised in a large urban area of the United States.
2. A single case study of an 8-year-old Italian boy, born and raised in a large city.

Both children presented with suboptimal development of the CFRC in early childhood and therefore both the diagnostic phase and therapeutic approaches were collaborative and multidisciplinary.

**Case 1 (by K. Boyd)**

The initial images of this 5-year-old girl demonstrate Class II mandibular retrognathia, anterior open-bite and habitual oral breathing (Fig. 2). After treatment, at 8 years of age, the images demonstrate complete resolution of mandibular retognathia, anterior open-bite and habitual mouth-breathing (Fig. 3).

**Case 2 (by S. Saccomanno)**

This case is that of an 8-year-old Italian boy with mouth breathing, palatal contraction, atypical swallowing, anterior open bite, and a finger sucking habit. The three phases of therapy included palate expansion and myofunctional therapy to correct oral breathing, myofunctional
therapy to correct chewing and atypical swallowing [Saccomanno et al., 2014; Saccomanno et al., 2019], and orthodontic treatment (Fig. 4, 5, 6) [Rosa et al., 2019; Paolantonio et al., 2020].

Conclusion

Our current environment is still affecting our growth and development both genetically and epigenetically. However, the dental community can educate the public and the patients on the importance of preventing the involution of our face and its life-long impact. Even the use of telemedicine which is increasingly widespread offers another opportunity to focus on prevention of OMDs by helping patients recovering their basic orofacial functions especially nasal breathing and chewing [Saccomanno et al., 2020].

These cases describe how orofacial myofunctional disorders (OMD) such as habitual mouth breathing, insufficient chewing and parafunctions contribute to the etiology and exacerbation of malocclusions, which may in turn impact the persistency and and worsening of the OMDs themselves. Through restoration of nasal breathing daytime and nighttime, and though promotion of optimal chewing and other orofacial functions, the CFRC will grow harmoniously, so that orthodontists can focus on providing perfect smiles.

Acknowledgements

The authors thank Giulia Giancaspro for drawing Figure 1.

References