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EC OPHTHALMOLOGY
Mini Review

Where Mouth Meets Eye

Patricia Valerio[1,2,3]*

[1]Department of Physiology and Biophysics, Federal University of Minas Gerais, Brazil

[2]Jaw Functional Orthopedics Discipline, FAOA, Brazil

[3]Jaw Functional Orthopedics Discipline, Itauna University, Brazil

***Corresponding Author**: Patricia Valerio, Department of Physiology and Biophysics, Federal University of Minas Gerais, Brazil.

Received: June 01, 2018; **Published:** July 03, 2018

Abstract

The dynamic development of orbital shape and volume during childhood creates several challenges for health professionals. There is a close relation with stomatognathic system formation. During prenatal development, the maxilla starts off as two centers of ossification: the premaxilla and the palatal process of the maxilla. They fuse at the premaxillary suture and superiorly up, around, the nasal cavity terminating on the frontal process, forming part of orbita floor. Beside bone relation that is also a strict connection between trigeminal and oculomotor systems. These interrelationship makes patients that present malocclusions more prone to specific ophthalmological problems.

On this mini-review we intend to draw the attention of health professionals to the necessity of further investigations on the multidisciplinary approach when treating malocclusion and/or visual problems.

Keywords: *Mastication; Eye; Vision; Crossbite; Myopia*

Introduction

Craniofacial development has traditionally been a field of research in which many divergent views are expressed and novel theories put forward to explain observed normal and abnormal phenomena. Decades of investigation have shown that craniofacial development is an intricate and complex series of events that require inductive and directive cell and molecular interactions to control the initiation, movement and differentiation of various embryonic cell populations across a spatial and temporal time continuum that results in the correct outgrowth, patterning and tissue integration required to make a face [1]. The development of the human head requires the integration of multiple structures: the vertebral column, brain, sensory organs, jaws, and associated nerves, muscles, blood vessels and skeletal elements - into a functional whole. This is a complex process relying on precise control of several critical regulatory pathways [2]. The soft tissue matrix, in which skeletal elements are embedded, is the primary determinant of growth, while both the bone and cartilage are secondary growth sites. Growth centers display inherent growth versus growth sites which are reactive. This is the fundamental premise of the Functional Matrix Theory. The soft tissue matrix (muscles, connective tissue, neural tissue) models the bone, rather than bone morphology being genetically determined [3].

The dynamic development of orbital shape and volume during childhood creates several challenges for health professionals. The orbital bones must be adequately stimulated and this will lead to full development, which will reduce the risk of craniofacial deformation in adulthood. In addition, it is important to understand that recovering of proper stimulus must be performed as early as possible, otherwise the patient can face untreatable asymmetries on adulthood [4].

The rigid bony orbital walls are formed by seven bones namely frontal, sphenoid, ethmoid, lacrimal, maxilla, zygoma, and the palatine. The orbits are surrounded by air containing paranasal sinuses and nasal cavity medially. The lateral wall is thickest formed by the greater wing of sphenoid and frontal process of the zygomatic bone. The orbital roof separates it from the anterior cranial fossa superiorly and the floor is formed by the roof of the maxillary antrum which is relatively thin. It is clear the importance of maxilla and the bones related to it on the establishment of orbita shape [5].

During prenatal development, the maxilla starts off as two centers of ossification: the premaxilla and the palatal process of the maxilla. These two centers ultimately fuse at the premaxillary suture which runs across the palatal surface of the maxilla posterior to the maxillary incisors, and superiorly up, around, the nasal cavity terminating on the frontal process, forming part of orbita floor [6]. So, it is completely understandable the relevant interface between maxilla and orbita formation as well as the importance of functional stimuli to allow adequate growth of both structures.

We also must understand that maxilla and mandible are connected by many different structures, and due to that, alterations on the cranio-mandibular connections can lead to alterations on orbita formation. Malocclusions not treated can lead to visual problems as well as visual problems can lead to altered mandible posture [7]. But the interface between stomatognathic apparatus and vision is bigger than bone structure. It is also extremely important to understand the close relation of trigeminal system and oculomotor system. There is an intricate relation. Wrong afferences of one system can alter the efferences in both. It means that to reestablish the correct stimuli from both systems will lead to a complete and correct development of the structures innervated by oculomotor and trigemio cranial nerves [8,9].

Considering the above statements, our aim on this mini-review is to provide, to different health professionals, the conscience of the importance of integrated approach in order to promote correct facial growth and development, focusing on visual problems etiology.

It is a new subject and a mini-review provides a concise and focused information about a question of current interest for the scientific community. It can open the frame for further investigations.

Materials and Methods

Using the PMC database, we searched for English-language articles, without temporal restriction or filters.

We used the following queries:

First searching: mastication AND orbit AND eye AND vision

We got 3 articles.

Second searching: crossbite AND vision

We got 4 new articles.

Third searching: astigmatism OR myopia OR Hypermetropia

We got 1 new article.

We also performed a search for articles on the references of the selected publications and found more 4.

Results and Discussion

In total 12 articles were found making direct connection between stomatognathic system and vision. They are listed on the references from 7 - 18. On table 1 the articles are placed in chronological order with the main topic stated.

Authors	Main Topic	Year
Cuccia, Antonino and Carola Caradonna	Emphasize the necessity of oculists and optometrists work together with dentists in case of malocclusions	2009
Herring, Susan W., *et al*.	Describe a syndrome where mastication leads to visual alterations	2011
Zhang, Jingdong., *et al*.	There is a neural pathway from masticatory neuros to oculomotor system	2011
Park, Chang Hyun, Dong Hyun Jee, and Tae Yoon La	Describe the association of malocclusions and convergence disorders	2013
Silvestrini-Biavati, Armando., *et al*.	Dental infections causing severe ocular tension	2013
Joshi, Nishitha, Ahmad M. Hamdan, and Walid D. Fakhouri	Found a link between skeletal malocclusions and vision problems	2014
Ciavarella, Domenico., *et al*.	Vision problems can lead to tension on masticatory muscles	2014
Mettu, Pradeep., *et al*.	Described a pathology called orbito-masticatory syndrome	2016
Marchili, Nicola., *et al*.	Review of the relation between malocclusion and ophthalmology	2016
Bollero, P., *et a*l.	High prevalence of motility disorders on unilateral crossbite patients	2017
Liang, Houcheng., *et al*.	Functional link between trigeminal proprioception and oculomotor system	2017
Zorena, Katarzyna, Aleksandra Gładysiak, and Daniel Ślęzak	Tension in masticatory muscles leading to Myopia	2018

Table 1

Clinical experiences in dental practicing claims that some cranio-mandibular characteristics could be connected to eye function. There is an integration among neck, head, tongue, mandible and maxilla relation, and vegetative answers. These structures innervations are directed connected to vestibular and oculomotor systems [7]. The embryologic origin of head structures creates an important network where each structure can interfere with the function of the other [15]. There may exist a trigeminal proprioceptive – oculomotor system neural circuit through jaw muscle afferents and this pathway seems to be related to vertical and torsional eye movements [9]. Marcus Gunn Syndrome (MGS), reported and described by Marcus Gunn more than 120 years ago, manifests as an abnormal eye movement and prompt eyelid retraction conjugated with jaw movement. The mechanism and neural circuits underlying the disease remains an enigma, and there is still no efficacious treatment for this disease. In clinical electro- myography (EMG) studies on the MGS cases, distinct co-firing of masticatory and extraocular muscles was recorded when both muscle groups were examined simultaneously indicating a direct connection between the two systems [8]. Intermittent visual symptoms (oscillopsia, double vision, vision loss) are common presenting complaints to the clinician and often due to ocular, systemic, orbital or central nervous system diseases. However intermittent visual complaints were found in the literature, related to the transmission of forces generated by contraction of the temporalis muscle against the soft tissue contents of the orbit [10]. Since temporalis muscle is active in all mandible movements, the treatment involves a multi-disciplinary team. Tension orbit is a clinical condition in which severe proptosis occurs with the intraorbital space compression that subsequently leads to deterioration of vision. It can happen on odontogenic orbital cellulitis, caused by dental infection and this condition emphasize the close relation of stomatognathic system and the eyes [12]. Postorbital ligament connects the inner part of zygomatic arch to the lateral wall of orbita. Contraction of the masticatory muscles can potentially distort the orbital contents and the postorbital ligament does function as a tension member resisting the pull of the masseter on the zygomatic arch [11]. Specifically related to the skeletal structures we must consider different types of malocclusion and the interface with different types of ophthalmological problems. Class II malocclusion patients (the maxilla in a sagittal view is in front of mandible) are more prone to Myopia [7,14]. It is known that the etiology of myopia is complex with genetic and environmental factors playing a role, but knowing that malocclusions can act as an etiologic factor allows the possibility of prevention. Myopia is usually treated with glasses, contact lenses, or surgical procedures. However, this kind of therapy is aimed at limiting the defect, not preventing it. Discovering probable mechanisms of brain-eye paths creates another step on the way to understanding and knowing how to prevent refraction defects in young adults. Without doubt, there is a need for further research in order to identify the most effective therapy of refraction defects. But for sure the prevention of skeletal malocclusions is an important aim [17]. Class II malocclusion patients are also more prone to convergence defects. On the other hand Class III malocclusion patients (mandible in front of maxilla) present an enhanced prevalence of ocular motility disorders while unilateral cross-bite patients have big tendency to both convergence and ocular motility disturbances [13,15]. We can even not forget that ophthalmological problems can also lead to posture alterations acting as a malocclusion predisposing factor [18]. Together this brief data collection advise that this interrelationship leads to a necessity of cooperation among different professionals such as physical therapists, dentists, oculists, optometrists, and ear, nose, and throat specialists [16]. This mini-review intends to stimulate al this professionals to start further investigations in order to better clarify the interface among these different areas of health science

Conclusion

There is a very close interface between stomatognathic functions alterations and the etiology of ophthalmological problems.

Conflict of Interest

The author declare that no financial interest and/or any conflict of interest exist.

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Volume 9 Issue 7 July 2018