

Chapter 6

The Interrelationships Between 3D Imaging, Digital Dental Occlusion, and Cranio-cervical Body Posture

Diego F. Tatis

Orthokinetic Training Center, Colombia

ABSTRACT

Presently, the functional description and the spatial distribution of the dental occlusion can be described and categorized with both qualitative and quantitative methods. Considering that the dental occlusion has a prominent role in the neuroconduction of the central and peripheral nervous systems, in the head and neck biomechanics, and in whole body posture, it is extremely necessary to diagnose what is outside the mechanical norm with digital biometry and either 2 or 3-D imaging, to develop occlusal and cranio-vertebral patterns that are compatible with the body mechanics, the neuroanatomy, the neuroconduction, and with optimal airway orientation. This chapter will describe qualitatively, quantitatively, statically, and dynamically, how the dental anatomy and dental occlusion, the intra - and inter-arch dental relationships, the three planes of craniofacial space, and the cranio-masticatory and cranio-vertebral components, are all neurophysiologically and biomechanically interrelated. The specific aims of this chapter are to outline new dental occlusion concepts as illustrated by digital occlusal biometric technologies and 3D imaging, while also proposing a practical method of performing a 3-dimensional anthropometric evaluation (known as the T.A.C. analysis). This approach utilizes anatomic data gathered by the latest generations of 2 and 3-dimensional images, which assists in understanding the impact that the Temporomandibular Joint orthopedics and differing skeletal maxillary and mandibular boney patterns have on the development of the dental occlusion.

DOI: 10.4018/978-1-6684-9313-7.ch006

INTRODUCTION

The development of digital technologies has directed clinical procedures towards interconnectivity and automation, through software programs, apps, and real-time data that can both diagnose and direct treatment. In this sense, extensive digital methods for collecting data become the raw material for designing and manufacturing clinical procedures or therapeutic elements. Such methods combine digital, physical, and biological systems in the daily practice of orthodontics, orthopedics, and maxillofacial surgery, as well as in other dental specialties. 3-Dimensional imaging is main data-mining procedure that in a more precise, accurate, and systematized way, interconnects a diagnosis with the needed treatment.

The future of dental medicine will undoubtedly be understanding the great influence occlusion has on the general health of both the cranio-masticatory system and on the whole body itself. Understanding the relationship between the dental occlusion and the body will contribute to solving not only dental problems, but also medical ones. Therefore, medicine and dentistry will have to learn a great deal from each other, in order to help patients whom today, have no apparent solutions to chronic conditions that have their causation within the cranio-masticatory system.

In recent years, technological developments have made significant diagnostic advances based on 3-Dimensional imaging, forcing us to visualize and think differently when performing both diagnostic and therapeutic processes.

The development of 3-Dimensional diagnostic imaging began in the 1960's with Computed Tomography (CT), which was initially created by an electronic engineer, Godfrey Newbold Hounsfield from the USA (Adams, Gansky, Miller, Harrell Jr., & Hatcher, 2004), and further evolved in 1972 by a physicist, Allan MacLeod Cormack from South Africa (Fisicanet.com.ar, 2022). They worked independently, but reached similar findings that led them to share in the Nobel Prize for Medicine in 1974. The first CT scanner provided solely axial cuts hence, it was named Computerized Axial Tomography (CAT scan).

The CAT represented a breakthrough in diagnostic radiography. The first uses in the history of dentistry of tomographic images dates back to 1934, when Heckman began to study rotational sonography with x-ray on curved surfaces. It was in 1948 when Yrjö Veli Paatero (Finland) conceived and developed the technique (Echarri, 1998). In dental maxillofacial radiology, rotational panoramic radiography was initially created to image the maxilla and the mandible (Hallikainen, 1996). The resulting image presented the anatomy from “ear to ear,” while also illustrating the TMJ region, which made it possible to perform a structural TMJ diagnosis (Iseberg, 2003).

Later in 1998, an orthodontist, Dr. Yoshinori Arai from the Nihon University School of Dentistry in Tokyo, Japan, developed the first dental tomographic scanner (Arai, Tammissalo, Iwai, Hashimoto, & Shinoda, 1999). The Ortho-CT was the precursor to today's Cone-Beam Computed Tomography, popularized by the acronym CBCT.

CBCT generates 3-Dimensional images to create a volumetric tomographic scan, combining the sagittal, coronal, and axial planes in a single imaging product. Unlike fan beam CT scanners, the characteristics of the cone beam x-ray merged software algorithms to obtain and process an image that illustrated patient soft tissue information. So, for the first time in dentistry, a 3-Dimensional image reported information about both the hard and soft tissues. Thus, precision and accuracy went hand in hand reliably reproducing clinical processes. Nowadays, CBCT is prevalent when obtaining data for the planning of clinical treatments, and for the design shapes and applications of differing dental devices. All of this has resulted in a new form of manufacture, wholly supported by software and hardware that carries out the fabrication process.

196 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:

www.igi-global.com/chapter/the-interrelationships-between-3d-imaging-digital-dental-occlusion-and-cranio-cervical-body-posture/363267

Related Content

Digital Occlusal Force Distribution Patterns (DOFDPs): Theory and Clinical Consequences

Robert C. Supple, DMD (2017). *Oral Healthcare and Technologies: Breakthroughs in Research and Practice* (pp. 1-74).

www.irma-international.org/chapter/digital-occlusal-force-distribution-patterns-dofdps/178981

Study Plans and Programs Supporting Geriatric Dentistry Teaching in Cuba: An Update

Dachel Martínez Asanza, Isis Anastasia Rojas Herrera, Anuli U. Njoku, Ana Clara Reyes Puig, Farida Mouloudj, Indira Gómez Capote and Gerardo Maupome (2024). *Geriatric Dentistry in the Age of Digital Technology* (pp. 174-191).

www.irma-international.org/chapter/study-plans-and-programs-supporting-geriatric-dentistry-teaching-in-cuba/335315

Dental Cone Beam Computed Tomography for Trabecular Bone Quality Analysis in Maxilla and Mandible

T. Christy Bobby, Shwetha V. and Vijaya Madhavi (2019). *Computational Techniques for Dental Image Analysis* (pp. 151-177).

www.irma-international.org/chapter/dental-cone-beam-computed-tomography-for-trabecular-bone-quality-analysis-in-maxilla-and-mandible/216047

Dental Tissue Engineering Research and Translational Approaches towards Clinical Application

Athina Bakopoulou, Gabriele Leyhausen, Werner Geurtsen and Petros Koidis (2017). *Oral Healthcare and Technologies: Breakthroughs in Research and Practice* (pp. 186-220).

www.irma-international.org/chapter/dental-tissue-engineering-research-and-translational-approaches-towards-clinical-application/178984

Recent Trends in 3D Printing of Dental Models: Rapid Prototyping in Dental Implants

Kayalvizhi Mohan (2019). *Computational Techniques for Dental Image Analysis* (pp. 217-237).

www.irma-international.org/chapter/recent-trends-in-3d-printing-of-dental-models/216051