Chapter 15

Understanding the Influence of Static and Dynamic Occlusal Forces on the Musculoskeletal System With Digital Occlusal Analysis

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ABSTRACT

Health literature explains poorly the association that the dental occlusion and the occlusal forces have on the human body. Quantified occlusal contact force and timing parameters have been largely ignored in studies that assessed human health. This chapter introduces a novel concept where biometric technologies objectively measure all the components of the Stomatognathic System (occlusion - T-Scan 10), muscles (EMG), Temporomandibular Joints (TMJ-JVA), mandibular movements (kinesiology-jaw tracking), nerves (TENS) and positional posture (Matscan), to relate their findings to human conditions that have escaped adequate therapeutic resolution. Clinical evidence from combining all of these technologies has linked opposing posterior teeth excursive friction and masticatory muscular hyperactivity to the etiologies of Trigeminal Neuralgia (TN), Meniere's Disease (MD), postural abnormalities, and cervico-cranio mandibular dysfunction (CCMD). This chapter will illustrate that resolution of some of these confounding conditions can be achieved by performing computer-guided occlusal adjustments aimed at reducing the occlusal surface excursive friction with Disclusion Time Reduction therapy (DTR) and the Immediate Complete Anterior Guidance Development Coronoplasty (ICAGD).

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INTRODUCTION

Dental Occlusion is more than the physical contact of the occlusal surfaces of opposing teeth, or the contact of their artificial replacements. Occlusion is more defined biologically as the functional interaction between the various cell populations that developed into the masticatory system, as they differentiate, model, remodel, fail, and repair (Lund, 1991).

Despite that this occlusal or musculoskeletal relationship may not meet the definition of the clinician's concept of an ideal or optimum occlusion, it must be appreciated that for every individual, the tissues of the masticatory system may have developed into a functional, stable, comfortable, and healthy equilibrium. However, treatment criteria become very important when that functional equilibrium is disturbed or when the occlusion is re-established. Occlusal treatment, therefore, should be considered on an individual basis, incorporating the specific physiologic needs of the various tissue systems within the masticatory system, rather than on a stereotyped, preconceived, or universal basis. It has long been established and recently proven that proper management of the occlusion is directly related to the successful treatment and maintenance of the teeth and the supporting tissues of the musculoskeletal system (the temporomandibular joint and the masticatory muscles)

Dental occlusion is one of the main stimulators (both neurophysiological and pathological) that leads to periodontal proprioceptive receptor activation. These are the peripheral processes of the neurons within the trigeminal mesencephalic nucleus (Vme) (Lund, 1991) and within the trigeminal ganglion (Lazarov & Chouchkov, 1996). Although still a controversial topic (D'Attilio, Caputi, Epifania, Festa, & Tecco, 2005; Festa, Tecco, Dolci, Ciufolo, Di Meo, Filippi, Ferritto, & D'Attillio, 2003; Gadotti, Bérzin, & Biasotto-Gonzalez, 2005), studies have indicated that the dental occlusion affects the biomechanical and viscoelastic properties, and the dynamic stability of several muscles like the sternocleidomastoid, the erector spinalis, the longissimus and the masseter muscles (Julià-Sánchez, Álvarez-Herms, Cirer-Sastre, Corbi, & Burtscher, 2019). The occlusion has also been reported to have an impact on one's gait, cervical posture, and motor ability, whereby different malocclusion traits have been seen to cause disorders at the cranial and cervical level, changes in muscle pattern; as well as impairments of body balance (Grosdent, O'Thanh, Domken, Lamy, & Croisier, 2014; Julià-Sánchez, Álvarez-Herms, Cirer-Sastre, Corbi, & Burtscher, 2019; Marchena-Rodríguez, Moreno-Morales, Ramírez-Parga, Labajo-Manzanares, Luque-Suárez, & Gijon-Nogueron, 2018; Michelotti, Rongo, D'Antò, & Bucci, 2020).

Neurons in the dorsomedial part of the principal sensory trigeminal nucleus (Vpdm-V, the 5th cranial nerve, the dorsomedial part of the sensory trigeminal nucleus) have been proposed to serve different functions, including relaying and processing sensory signals from the head, like tactility and trigeminal proprioception (Luo, Wang, Peng, & Li, 1991), likely because of the central process of the Vpdm projects to the cerebellum (Ge, Li, Tang, Ma, Hioki, & Zhang, 2014). In the granular layer of crus 1, crus 2, and lobule 9 in the cerebellar cortex, there are projections from the dorsal half of the principal sensory trigeminal nucleus (Darian-Smith & Phillips, 1964; Ge, Li, Tang, Ma, Hioki, & Zhang, 2014; Van Ham & Yeo, 1992). Reports have indicated that there are projections from Vme to the facial nerve nucleus, the hypoglossal nerve nucleus, the trigeminal motor nucleus, the nucleus ambiguous, the accessory nerve nucleus, and Vpdm (Ge, Ma, Hioki, Wei, Kaneko, Mizuno, Gao, & Li, 2010; Magnusson, Clements, Larson, Madl, & Beitz, 1987; Pang, Li, Nakamura, Wu, Kaneko, & Mizuno, 2006). Comparatively, in female rats treated for unilateral anterior crossbite (UAC), the Vesicular glutamate transporter 1 (VGLUT1) mRNA expression level of Vme was upregulated (Liu, Zhang, Wang, Zhang, Liu, Li, & Wang, 2017) and the VGLUT1 protein expression level of the facial nerve nucleus, the hypoglossal nerve nucleus, the

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