The association between Occlusion Time and Temporomandibular Disorders

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ABSTRACT

Introduction: Recently, some published studies show there is a multifactorial origin for Temporomandibular Disorders, but the dental occlusion's contribution to the development of Temporomandibular Disorders, and how it may influence the adaptive capacity of the Stomatognathic system, it's still unclear. The aim of this study is to evaluate the correlation between the Occlusion Time and Temporomandibular Disorders. Methods: A total of 54 patients were enrolled in the study (24 males and 30 females, mean age 27.94 ± 8.21 years). The TMD group (8 males and 10 females) consisted of subjects who presented with at least 1 of the following signs of Temporomandibular Disorders: Temporomandibular Joint sounds (clicking or crepitation), Temporomandibular Joint locking episodes, limited mandibular opening, painful limitation of mandibular movements, pain to palpation of the Temporomandibular Joint or of the masticatory muscles. The control group (16 males and 20 females) presented as free from Temporomandibular Disorders. The T-Scan III computerized occlusal analysis system was to record the subjects' Occlusion. Times during eight mandibular opening–closing movements. Results: The two-ways ANOVA test analyzed the variations for group and sex, showing that the TMD group mean Occlusion Time (0.64 ± 0.21 s) was statistically significantly longer than the control group mean Occlusion Time (0.45 ± 0.17 s) ($p < 0.001$). Significant differences were also found for gender where the mean OT of female subjects was longer than males one with statistical significance (p-value < 0.01). Conclusions: The computerized analysis of the Occlusion Time in patients affected by TMJ problems has to be carefully considered as adjunctive instrumental device.

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1. Introduction

Temporomandibular Disorders (TMD) is a collective term which includes a group of clinical conditions affecting the stomatognathic system, in particular the muscles of mastication and the Temporomandibular joints (TMJ), which is characterized by a group of commonly reported symptoms: fairly localized pain, limited or asymmetric mandibular movements and TMJ noises (crepitations or clickings) (Okeson, 1997).

Because of the different methods used to assess TMD symptoms, which are often subjective, literature reports that the world-wide prevalence of TMD varies between 7% and 84% of the population within an age range of 3–74 years (Luther, 2007). Mostly it seems to afflict 10% of the population over 18 years of age, where chronic pain is experienced in the Temporomandibular region (LeResche, 1997).

In fact, because of the variability of the symptoms of this cluster disorder, that potentially confirm a diagnosis of TMD, it has been quite problematic to isolate a primary etiology that predisposes the patients to suffer symptoms, leading researchers to advocate that TMD is of multifactorial etiology. Possible causes for TMD are Bruxism, mandibular muscle activity, facial growth, and also other systemic, postural, metabolic, structural, traumatic, psychological, social and behavioral influences, which have been identified as possible predisposing, initiating, and maintaining factors for TMD (Baldini et al., 2013a; De Boever and Carlsson, 1994).

For many years Dental Medicine had considered an unfavorable dental occlusion as a principal cause of the occurrence of TMD, because TMD appeared to be more frequently observed in patients with compromised or excessive vertical dimensions (De Boever et al., 2000).

However, later studies suggested TMD had a multifactorial origin such that dental occlusion was considered to be only one factor that may affect the adaptive capacity of the Stomatognathic

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system, which could lead to the development of TMD (McNamara, 1997).

Recent review articles (Luther, 2007; Türp and Schindler, 2012) underline that the evidence supporting a relationship between occlusion and TMD is still not voluminous, such that the authors suggested that the occlusion played a minor role in the development of the signs and symptoms Temporomandibular Disorders, noted that it would be important to establish evidence that a true cause and effect relationship exists between occlusion and TMD (Tecco et al., 2011).

The introduction of the Research Diagnostic Criteria for TMD (RDC/TMD) Axis I, provided standardized criteria for the diagnosis and classification of the different forms of TMD, categorizing them in three groups: Group I muscle disorders, Group II disc displacements and Group III other common joint disorders.

The RDC facilitated creating statistically better intra- and inter-examiner reliability when clinicians were observing and reporting patients signs and symptoms and provided a common model for any examiner (Manfredini et al., 2006).

However, the frequently made, non-standardized diagnosis of TMD (absent of RDC/TMD international standards), combined with the low quality of some study designs, and, most importantly, the imprecise and subjective evaluation methods used in these studies to assess various aspects of the dental occlusion, have reduced the trustworthiness of these previous studies results (Baldini et al., 2012a).

The occlusal evaluation, in many studies that suggest occlusion is a minimal component in TMD etiology, have been routinely carried out with subjective methods:

the visual analysis of static occlusal contacts using articulating paper or occlusal wax, the visual analysis of dynamic occlusal contacts during voluntary or manipulated mandibular movements, the visual intra-oral analysis of the occlusion and the measurements obtained using millimeter rulers (Baba et al., 2000). This type of visually-gauged clinical examination is difficult to standardize (Wang and Yin, 2012) and has a limited reliability and validity, thus its trustworthiness and accuracy for research purposes is poor, and brings into question the conclusions of these studies that are based upon weak results (Gazit et al., 1986; Carey et al., 2007).

Considering these remarks, in research studies, the use of technology has become fundamental and should be encouraged. The research method then employs a sensible approach that can standardize measurements for comparisons of subjects, and provide measurable guidelines for improving conditions seen in daily practice (Manfredini et al., 2012; Baldini et al., 2013b).

Over the past 30 years, the evolution of diagnostic instrumentation, together with the clinical experience of practitioners, has given dental professionals a digital instrumental support, that improve the quality of information used in the diagnostic analysis (Baldini et al., 2012b, 2009). In 1987 Maness et al. (1987) reported the development of the first computerized system designed for occlusal analysis (T-Scan I, Tekscan, Inc. Boston, MA, USA). Notwithstanding its early problems (Harvey et al., 1992), its hardware and software evolution over the past 30 years, and improvements made to this technology which are included in the T-Scan III version (T-Scan III, Tekscan Inc. Boston, MA, USA with T-Scan HD sensor), ensured it is precise and reliable (Koos et al., 2010; Hirano et al., 2002).

The T-Scan III system allows for the recording the Occlusion Time (OT), which is a dynamic parameter defined as the elapsed time from initial tooth contact until maximum intercuspation is reached in centric occlusion (Kerstein and Grundset, 2001). It is directly related with each subject's occlusal contact pattern (Wang and Yin, 2012), thus some studies have considered this dynamic parameter as capable of describing a subjects' occlusion (Cheng et al., 2012; Sierpinska et al., 2008).

The aim of this study is to evaluate if there exists a correlation between Occlusion Time and Temporomandibular Disorders.

2. Materials and Methods

2.1. Subjects

A total of 54 Italian Caucasian patients were enrolled in the study (24 males and 30 females, mean age 27.94 ± 8.21 years) at the University of Rome Tor Vergata.

The ethical committee of the institute approved the protocol where all of the volunteers signed an informed consent form prior to their participation. An oral and anamnestic examination and TMJ screening of the subjects, was performed to seek out dental occlusion abnormalities or TMD present in the subjects. All the volunteers had to meet the following inclusion criteria: good general health according to a medical history, complete permanent dentition except for the third molars, absence of periodontal disease, absence of cast restorations and extensive occlusal restoration (less than 3 teeth with onlay restorations), occlusal Angle Class I or II (bilaterally assessed), absence of previous orthodontic therapy, absence of crossbite, absence of previous facial or mandibular traumas, good compliance with oral hygiene, absence of neurologic disturbances, absence of orthognathic surgery.

The enrolled subjects were divided in two groups: the TMD group (8 males and 10 females) affected by unilateral, long lasting, TMD muscle pain diagnosis (group Ia or Ib), disk displacements with reduction (group IIa), according to the RDC/TMD, axis I TMD and with presence of at least 1 of the following signs: TMJ sounds (clicking or crepitation), TMJ locking episodes, limited mandibular opening, painful limitation of mandibular movements, pain to palpation of the TMJ or of the masticatory muscles.

In particular, 8 subjects were affected by mild TMD and 10 subject by moderate TMD; 10 subjects were diagnosed for TMD group Ia, 5 subjects for TMD group Ib, 3 subject for TMD group IIa.

The control group (16 males and 20 females) subjects were healthy and free from all of the TMD symptoms described above in TMD group.

All subjects were unaware of the aims and/or design of the study.

2.2. Equipment, procedure and statistical analysis

The T-Scan III is a sophisticated computerized occlusal analysis system, that illustrates both static and dynamic occlusion. It can be used to analyze tooth contact patterns that occur within every mandibular movement (centric relation, centric occlusion, lateral excursions and protrusion), which can all be recorded in various mandibular postures, and body postures, as well. Therefore, the T-Scan system is much more than a simple evolution of an occlusal wax wafer, or a strip of articulating paper. Waxes and papers can visualize the occlusal contacts to the clinician, but do not show the occlusal force relationships between opposing occlusal contacts. Nor can they describe the order of sequential contact timing, nor how long each contact is maintained.

The T-Scan III device (Tek-Scan Inc., Boston, MA, USA) is approved as a "medical index center – scanning sensor system. It has multiple levels of recording sensitivity that can be adjusted at will, to match the recording level within the recording sensor, to the occlusal force exerted by the patient. The hardware comprised of a recording handle (which holds the recording sensor) that is connected to the computer through a USB port. Held securely within the recording handle is a "sensor support", which keeps the 100 μm thick recording sensor properly extended flat