

Influence of the Variable Loading Factor on the Masticatory System and the Temporomaxilar Joint and Its Correlation with the Clinic

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Abstract

The integral analysis of the Temporomandibular Joint (TMJ) and the osteo-ligament-articular and muscular structures was carried out together with their associated neural network. This determined the high degree of correlation of the factors that affect the dynamic-functional balance of the Temporomandibular System (TMS) and the self-dynamics of the System.

Finite element studies were used to represent the effects of load factors (G forces) in the laboratory and over military combat aircraft, to try to extrapolate the results to field work. The dynamic parameters of the TMJ were measured, using a variable load factor (force G) imposed on the pilots in a sequence of military flights.

The application of sustained load factor allowed to visualize in a short period of time, what would take a researcher years to observe, about the typical anomalies of the temporomandibular system and the associated dynamic structures in a patient, besides being able to study the relaxation time that the masticatory system needs, in order to recover its physiological stability, understanding which are the adaptation mechanisms for it.

It was determined that not only asymmetric efforts (responsible for the multiple positions of each tooth or dental prosthesis), are responsible for generating harmful loads on the Temporomandibular System, but also have a high degree of correlation, in general, with the damage caused at the TMJ, due to alterations in biomechanical lever systems.

Therefore, the methodology of dental treatments must be reconsidered, starting from functional recovery, through appropriate biomechanical mechanisms, to then give way to the corresponding dental rehabilitation, which will result in the functional stability of the masticatory system, dental-prosthetic rehabilitation and the balance integral of the body understanding the masticatory system, as an integral part of a Whole (Holistic Vision).

Keywords: TMJ, Temporomandibular System, Functional Dynamic, Biomechanical Lever, Variable Load Factor, Integral Holistic Vision, Factor Correlation

Materials and Methods

After this stage, work was carried out in the field, during the year 2000, in the facilities of the Military Aviation School. The aviators that participated in these tests were under strict psychophysiological control and were previously selected by the research team, to rule out any type of alteration of the ATM, making the corresponding Clinical History and complementary image studies for each of them. (CT, MRI, Orthopantomographies, Condilographies and Cranial Profile Teleradiographies). In addition, devices were used to measure

masticatory forces (Load Cells) and surface electromyography. There were no bone, joint and / or muscle alterations in them. During the present research work, 1674 records of the mandibular dynamics (Condilocomp LR3 equipment of Kavo Dental) were performed under a variable load factor in 12 military pilots and were related to the symptoms and signs presented by patients diagnosed with Temporomandibular Dysfunctions treated at the Cordoba Aeronautical Hospital. By using the variable load factor (3G positive to 1G negative), it was possible to understand the process of fatigue of human material throughout life (1 Hour of Flight = 3 years of bruxism) and how to help compensate them through orthopedic treatments bound to respect natural biomechanical processes.

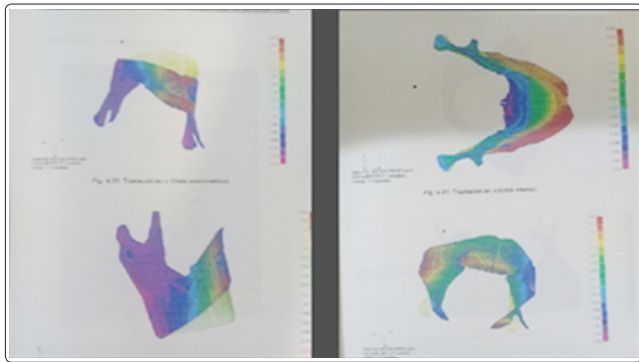


Figure 1: Computer simulations of variable loads in the bone structure, using Nastran software

This allowed verifying the veracity of the theory proposed by the team of researchers, of the dynamic alterations of the Temporomandibular System over time, in total agreement with the experimental field studies on the pilots. When making the measurements in the combat aviators, the maneuvers and sequences that each of them would have to perform in flight were standardized and the dynamic records were taken before and after each flight, resulting in the visualization of the effects that the variable load factor produced when applied in combat aviators, which has similarity to the fatigue factor of the body structures that produce stress, only that the latter does so in a milder and sustained way over time, generating Asymmetric and asynchronous adaptations that go unnoticed by most patients and health professionals.



Figure 2: Aeronautical material used for the field study: Aircraft IA 63 “Pampa”

Table 1: Intervening multidisciplinary team

	Intervening professionals
Medical areas	Aeronautical dentistry
	Aeronautical doctors
	Specialists in bioimágenes
	Nutritionists
Technical areas	Military pilots
	Aeronautical engineers
	Electronic engineers
	Engineers in systems
	Programmers
	Aeronautical technicians

Scientific areas	Master in physics
	Master in mathematics

These post-flight measurements were evident to the visual observation of the research team, since the facial symmetry could be appreciated before starting the flight and after returning from it. With the laser light equipment (Condilocomp LR3 equipment of Kavo Dental) of measurement by beams, it was possible to detect with accuracy the displacement of the mandibular condyles and the protective co-contraction responses of the associated muscle groups, triggered by the effects of central excitation that each individual generated, under the effects of the applied load factor.



Figure 3: Post-flight asymmetric responses

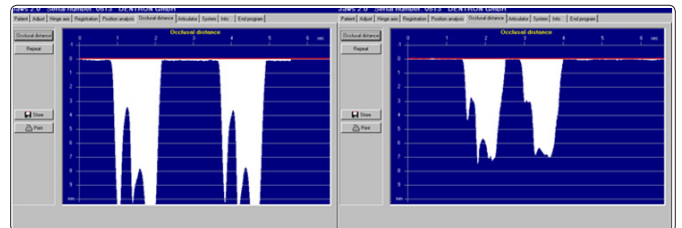


Figure 4: Comparison of the reduction of the inter-occlusal free space before and after the flight in the same pilot, by the protective co-contraction response to the stress of the flight

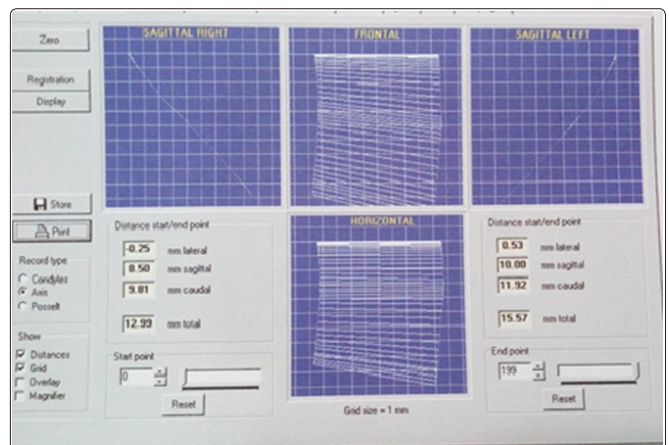


Figure 5: Comparison of the condylar routes before the flight of the same pilot

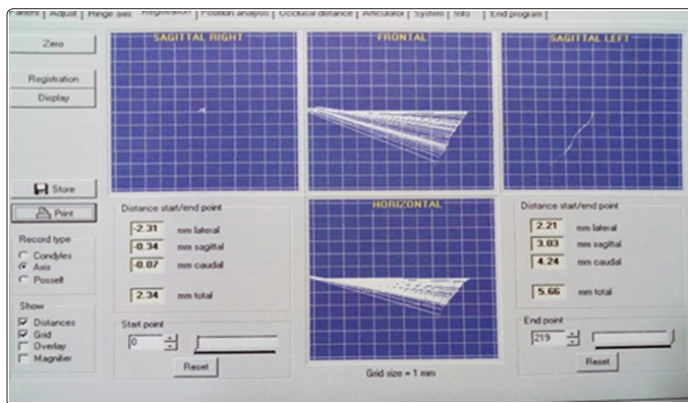


Figure 6: Comparison of the condylar routes, occurred 5 minutes after the flight of the same pilot, observing the modification of the condylar paths, concordant with the facial asymmetry

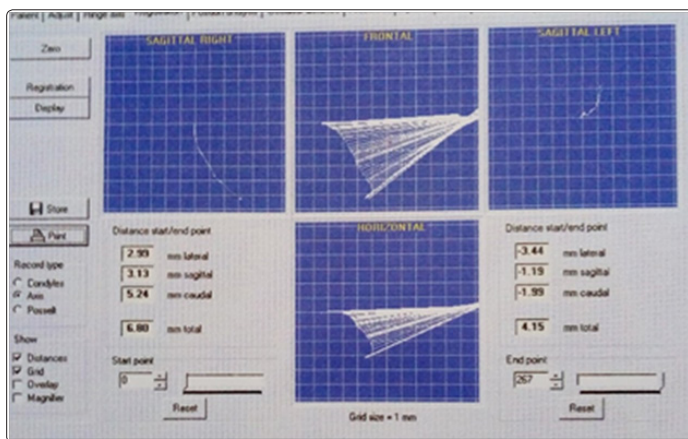


Figure 7: Modification of the condylar paths to the opposite side after 20 minutes of the flight, demonstrating the asymmetric compensations in the same pilot

Results

During the year 2001, the data obtained was evaluated and conclusions were reached that this should be taken for exclusive military use. However another important finding emerged: these parameters could be extrapolated to understand the pathology currently called: “Temporomandibular Disorder Syndrome” in ordinary patients, dependent on the Institute of Social Work of the Armed Forces (IOSFA), which currently consists of approximately 700,000 members. Therefore, the study required three years of work, 360 hours of flight, 2600 man / work hours which lead to modifications of the corresponding military area the clinical work protocols, flow diagrams and the algorithm developed for the creation of the first simplified calculation program for the preparation of the different mandibular orthosis, giving specialized dental care to the population of IOSFA.

The “Facial Pain and Temporomandibular Disorders” Department at Cordoba Aeronautical Hospital, from 2001 to 2018 (17 years) worked with 28,500 patients under this protocol, with 96% efficiency, being the pathologies generated and treated in this Syndrome the following:

- Tension headaches 95%
- Nonspecific throat discomfort 40%
- Generalized dental abrasions in different degrees 100%
- Generalized retractions of gums 60%

- Anfractures of dental necks 38%
- Tinnitus (noises in the ears) 40%
- Noises in the TMJ (Temporomandibular joint) 80%
- Idiopathic peripheral facial paralysis 5%
- Dizziness 20%
- Snoring and Obstructive Sleep Apnea Syndrome 30%

Due to the symptoms mentioned above, this syndrome could be resolved successfully, working approximately during 200 working days per year for 17 consecutive years (8.38 patients per day). For the different activities and for the same Syndrome, eight types of orthosis were created:

- Orthosis of mandibular relocation
- Joint Damage Brake Orthosis (JDB)
- Orthosis for orthodontics
- Orthosis for oral rehabilitation
- Orthosis for treatment of condylar neck fractures
- Orthosis for snoring and SOAS
- Orthosis for sports optimization

Conclusion

These orthosis respond to the different scientific based procedures that a professional needs to respond to the needs of patients, always respecting biomechanical principles and their fundamental differences with: “Discharge splints”, “Myrelaxing plates”, “Relaxation plates”, etc.: “For the construction of the orthosis, the biomechanical principles of the masticatory apparatus, the influence that this has on the posture (head and cervical column relationship) are respected based on the improvement of the original algorithm, which also gave rise to the software MeSer®.



Figure 8: Software MeSer®

This software indicates the exact measurement of the Vertical Dimension and its pantographic relationship with the ATM, compensating the damage that they may have suffered by modifications of the heads of the condyles or displacements of and / or thinning of discs”. All this avoids the need to acquire expensive equipment, which complicates the access of professionals to this discipline allowing them to use low-cost image studies that can be easily carried out in almost the entire planet (Orthopantomographies and Condilographies).

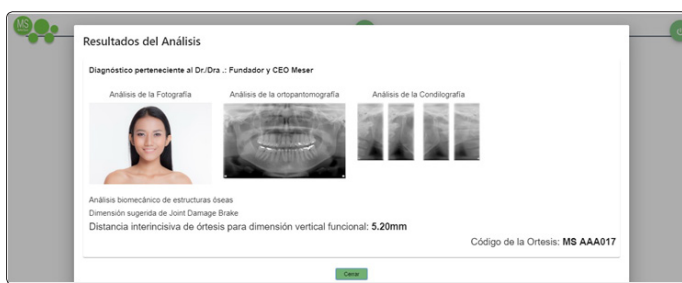


Figure 9: Vertical dimension obtained with MeSer® using radiographs

The paradigms offered by gnathology should be reviewed to explain the dynamic behavior of the Stomatognathic System and recognize the multifactorial causes of the Temporomandibular Syndrome and the way in which it reacts to stress and how to counteract its harmful actions, demonstrating that functional balance is achieved after the compensatory imbalance. Stress caused by acrobatic flight in healthy patients.

Thus, by developing preventive criteria, on strictly curative ones, functional and structural alterations can be resolved increasing the quality of life of people and also avoiding disbursements in the social security systems.

It is clear that 1 (one) intraoral dental device is not useful for the needs of all patients and that there is a need to give permanent training to ATM and Facial Pain specialists to provide solutions based on the scientific method as well as to train new specialists committed to work with scientific discipline.

The degree of effectiveness of the treatment and the software can easily be observed and this allows to extrapolate aeronautical technology to civilian attention, leaving aside personal abilities or aptitudes as the only attribute for a good performance in the activity although the experience of each professional always plays an important role when making decisions, as it is in any activity. This work shows that the use of the load factor as a temporary modulator of aging effects in the body processes associated with ATM and its complementary structures is the best known way to evaluate, in a short period of time, the effects of long temporal correlation, that the incident factors of Stress generate daily on the Temporomandibular System of each individual [1-20].

Acknowledgement

The present research work was developed to respond to a biomechanical phenomenon, with functional structural aging of the psychomotor skills of the combat pilots that, up to the date of its realization and until today, had no significant and / or relevant references for the development of the research presented here. For all this, there are no previous references to this work, except the general science, which could design a long list that would not be of any guide for the reader. However we will expose those who were the founders of our basic knowledge in ATM.

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