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OCLUZO-ARTICULAR AND NEUROMUSCULAR REHABILITATION METHODS IN IMPLANT-PROSTHETIC ORAL REHABILITATION

PHD THESIS SUMMARY

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PhD Thesis Summary

The aim of this thesis is to identify certain working protocols with the help of which we can obtain a balanced prosthetic work from an implant, articular, occlusal, neuromuscular, aesthetic point of view and which fulfills all six functions of the stomatognathic system: breathing, mastication, posture, phonation, aesthetics and stress management.

In this sense, this doctoral thesis is structured in two large parts: the general part and the part of personal contributions, each of the two parts being divided into several chapters.

The first chapter of the general part aims to present some fundamental aspects of anatomy. This chapter begins with a section presenting the cranio-mandibular system. We note in this section that the building block of the nervous system is the nerve cell or neuron. In the specialized literature, it is shown that there are several types of nerve cells, but their general structure is the same, including a cell body, dendrites and axon. At the same time, in this section we also briefly discussed the role of the neuromuscular system in the functional activity of the mandible. Thus, from the literature review, it was determined that the contribution of muscles to oral activity is governed by the architecture of bone structures and the muscle attachment on these structures, the occlusal relationships of the teeth, the requirements of different types of food and the innate functional model or acquired by the individual.

The second section of this chapter focuses on a detailed presentation of the temporomandibular joint. The temporomandibular joint (TMJ) is a remarkable anatomical structure that plays an important role in complex mandibular dynamic movements. Located bilaterally in front of the ears, the TMJ connects the mandible to the temporal bone of the skull. This joint allows for the essential movements involved in breathing, chewing, speaking and facial expressions, making it a vital component of daily activities. The TMJ is a synovial joint that includes several components: the mandibular condyle, the articular fossa (glenoid fossa) of the temporal bone, the articular disc, and a variety of ligaments and muscles. The joint design allows for both rotational (hinge-like) and translational (lateral, protrusion and retrusion) movements for opening and closing the mouth. When the left sagittal section is taken, the following components of the TMJ can be seen: articular tubercle, mandibular fossa, articular disc, mandibular head, mandibular neck, mandibular lingula, mandibular foramen, mylohyoid groove, and pterygoid fossa. At the same time, it is observed that the insertion of the temporal muscle is present on the coronoid process, and on its medial face there is a crest, which is called the temporal crest.

The temporomandibular joint is considered the most complex joint in the body and has a unique anatomical design that facilitates essential functions of the human body. Despite its resilience, the TMJ is susceptible to dysfunction, leading to disorders of the temporomandibular joint. Understanding the anatomy, function, and potential disorders of the TMJ is essential for both health professionals and individuals. Through a responsible medical approach, using an advanced dental diagnosis, we can offer patients with tooth decay functional treatment plans with the aim of protecting the 2 temporomandibular joints and the neuromuscular system of the masticatory apparatus. For edentulous patients, the treatment plan includes clinical office steps and technical laboratory steps. This treatment plan structure is a complex one due to the fact that the prosthetic work is performed extra-orally in a dental laboratory.

In the next section of the first chapter, we will discuss the dynamics of the stomatognathic system, more precisely the movements of mandibular dynamics. Mandibular dynamics is guided by the muscles of the cranio-mandibular system and supported by the morphology of the occlusal faces of the teeth present on both arches.

The maxilla is a robust, U-shaped bone that forms the upper jaw, in which the upper teeth are implanted. It is firmly anchored to the skull and, unlike the mandible, is not mobile. However, the jaw plays an essential role in facial dynamics, influencing key movements and functions.

In turn, the mandible or lower jaw is an anatomical structure involved in essential functions such as speech, mastication and the expression of emotions. Its mobility is a testament to the complex interplay of muscles, joints, and neural control, making it an essential component in the dynamic functionality of the human face. The muscles responsible for mandibular movements play an essential role in the complex coordination of this anatomical segment and include the temporalis, masseter, medial pterygoid, and lateral pterygoid. There are mainly six types of mandibular movements, including mouth opening and closing, right and left laterality (translation), and protrusion and retrusion movements. Translations can be described along axes that are, for example, anteroposterior (frontal plane) or X, mediolateral (vertical plane) or Y, and supero-inferior (horizontal plane) or Z. Rotations can be defined by terms such as azimuth (about the Z axis), elevation (about the Y axis). However, the lower jaw does not move freely, being guided bilaterally by its joints, and although translations and rotations about any of the three independent axes remain possible, they are no longer independent. The specialized literature shows that in the sagittal plane, the mandible can perform a pure rotational movement and can also perform translations. Within the horizontal plane, the mandible has the ability to rotate around several axes. In lateral movement, the functional component (also known as Bennett movement or lateral mandibular displacement) moves slightly forward or backward, while the nonfunctional component (the condyle located in the orbit) moves in a predominantly forward and medial direction. In the frontal plane, the non-functional condyle moves downward and medially, while the working condyle rotates around the sagittal axis. Occlusal contacts are established between the maxillary and mandibular dental arches, and the quality of these contacts has a significant impact on the efficiency of mastication. The patient's nutritional status largely depends on dental health, and the mastication process involves complex movements of the mandible, requiring precise coordination between the temporomandibular joints and the muscles involved in mastication.

Later, in the fourth section of the first chapter, he focuses on the description of Bonwill's plan. In this sense, by studying the materials in the field, I was able to observe the fact that G. Bonwill, an American dentist, proposed in 1858 an equilateral triangle, the foundation of the Bonwill occlusion theory. Based on extensive measurements of 6,000 skulls and 4,000 living individuals, this theory states that the ideal arch must be symmetrical. The length of each side of the triangle is about 4 inches and is formed by connecting the centers of the two condyles, namely the right condyle and the mandibular inter-incisor point between the two lower central incisors, and the left condyle and the mandibular inter-incisor point between the two central incisors inferiors. Although Bonwill's measurements are not considered sufficient as scientific evidence, and the average size of his triangle remains relative, his theory underpinned the construction of the average articulators, and similarly, Monson's pyramid is based on the Bonwill triangle.

The fifth section of the first chapter continues with a brief description of Spee's curve. Through the review of the specialized literature, we can conclude that the curve of Spee is a natural anatomical feature in dentistry, which describes the gentle curvature of the occlusal plane from the tip of the mandibular canine to the posterior region, ensuring optimal tooth contact during jaw closure. The curve of Spee plays a crucial role in the stability and efficiency of the masticatory function, promoting the uniform distribution of force on the dental arches and minimizing the risk of occlusal interference, thus contributing to a harmonious occlusion. Dentists carefully consider the Spee Curve when planning dental treatments and occlusal adjustments, recognizing its importance in maintaining proper occlusal relationships and preventing potential problems (interferences) such as premature contact and temporomandibular joint disorders.

At the same time, in this chapter I also presented some aspects related to Wilson's curve and Monson's spherical theory. Wilson's curve is another important concept in dentistry, referring to the lateral curvature of the dental arch from side to side. This anatomical feature complements the Curve of Spee and contributes to the overall stability of the occlusion. Its configuration is concave in the mandible and convex in the maxilla, being recognized for facilitating intercuspation and maintaining occlusal stability.

With regard to the mandible, Andrews noted that Wilson's curve shows a progressive accentuation of the mid-arch to the posterior region in individuals with normal occlusion. This is due to the appearance of an upward growth of the lingual coronal tip towards the second molars. Dentists consider Wilson's curve when evaluating interproximal contacts between teeth, helping to establish proper alignment and prevent problems such as lateral interference during jaw movements. The harmonious interplay between the Curve of Spee and the Curve of Wilson is crucial in achieving a well-balanced occlusion, ensuring efficient function and stability in the oral environment.

Monson's spherical theory, proposed in dentistry, revolves around the concept that tooth contacts and occlusal relationships ideally conform to a segment of a sphere with an 8-inch diameter centered around the glabellar region. This theory assumes that achieving harmonious occlusion involves aligning the cusps and incisal edges of the teeth with this imaginary spherical surface, contributing to optimal stability and function within the dental arch. Dentists often consider Monson's spherical theory when evaluating occlusal harmony and planning treatments to improve the overall occlusal pattern.

Afterwards, we chose to discuss Posselt's diagram as well. Through the information found in the literature, I concluded that Posselt wanted to study the ability of the mandible to move in the occlusal and sagittal planes. Through his study, it was determined that habitual movements do not generally coincide with borderline movements, habitual movements show considerably greater variability in individuals than borderline movements, rest positions and intercuspation position generally differ from the position of retrusion of the mandible. Posselt defines the term "border movements" as the ability to move the mandible. At the same time, he also determined that the range of movement of the mandible in the sagittal and horizontal planes is characteristic of the individual, but varies in different people.

Next, the ninth section of this chapter provides important information about the concept of Bennett's angle. The Bennett movement mechanism highlights the rapid synchronization of muscle actions in lateral movements of the mandible. In a lateral movement to the right, the left lateral pterygoid muscle is the prime mover, and the posterior fascicles of the right temporalis muscle contract to keep the right condyle fixed, allowing the mandible to rotate around it. The contraction of the retractor fibers of the rectus temporalis muscle occurs after an initial swing of the mandible, thus avoiding excessive stress on the joint capsule. Factors influencing this movement include the shape of the joint fossa, loosening of the capsular ligament, and contraction of the medial pterygoids. Bennett movement exerts a significant impact on the cuspid pathways, and the degree of lateral displacement influences the relative positions of the working and balancing cuspid pathways on the mandibular and maxillary teeth. With a higher lateral displacement (large Benett angle value), the cuspid paths become more medial on the mandibular teeth and more distal on the maxillary teeth, and vice versa when the lateral displacement is smaller (lower Benett angle value). The clinical importance of the Bennett movement is evident in the changes in occlusal morphology, especially in the immediate phase of lateral movement. This initial phase significantly affects the width of the central grooves of the posterior teeth and the inclination of the cusps. Obtaining a precise occlusal morphology without deviating from the trajectory of the occlusal contacts requires the induction of the Bennett movement, since in this phase there may be minimal variations in the condylar inclination and the functional space (convex-concave palatal faces of the bilateral superior frontal group), this Bennett movement influencing and inclination of the incisal plane of the upper and lower front group.

The tenth section of this chapter explores the significance of the facebow (active bow - passive bow) in dentistry, delving into its impact on dental and facial aesthetics. Thus, we could conclude that the facial arch is a crucial element in the evaluation and planning of prosthetic dental treatments, having a significant impact on facial aesthetics. Dentists carefully analyze the shape of the insitu or articulator facial arch during functional and aesthetic prosthetic procedures to create, with the help of the final prosthetic work, a natural overall appearance of the lower floor and facial aesthetics as natural as possible. In prosthetics, the facial arch is an important element of diagnosis and planning, and deviations from the "ideal shape" of each case can lead to malocclusions and facial disharmony. Dental prosthetics, especially dental implants, bridges and dentures, play an essential role in the restoration and redesign of the facial arch in case of missing or damaged teeth. These procedures not only replace missing teeth, but also maintain or restore the natural curves and proportions of the facial arch (Curve of Spee, Curve of Wilson). The goal is to ensure a balance between the restored dental structures - the neuromuscular system - mandibular dynamics (TMJ anatomy) and the surrounding facial features, contributing to a natural and pleasant aesthetic appearance. In this sense, we can state that the facial arch is an extremely essential element in dentistry, because it has a significant influence on facial aesthetics, the health of the temporomandibular joint, as well as the general well-being of patients.

In what follows, the last two sections of the first chapter focus on two extremely important concepts in dentistry, namely: dental occlusion and the angle of occlusion.

Occlusion refers to how the teeth meet when the maxilla and mandible come together, influencing oral functionality and aesthetics. When it works optimally, the occlusion facilitates the correct functioning of oral activities, contributes to dental aesthetics and prevents possible disorders of oral function. Dental occlusion is not only limited to the physical contact of occlusal surfaces, but is biologically defined as a coordinated functional interaction between different cell populations in the masticatory system. Morphological variations are considered normal in this complex interaction involving the differentiation, patterning, remodeling and repair of cells of the masticatory system. There are five essential principles of occlusion that must be considered during dental restorative procedures to ensure long-term stability and identify potential instabilities and imbalances. These principles are crucial for occlusal analysis and design to reduce stress on the masticatory system, including the masticatory muscles, teeth, periodontium, temporomandibular joint, and prosthetic restorations. These principles include the Retruded Axis (RAP) or Centric Relation (CR) position, around which the Retruded Contact (RCP) or Inter Cuspal Position (ICP) position is achieved, mutually protected occlusion, the importance of anterior guidance, the absence of lateral interference, and the maintenance of posterior stability.

If anterior and/or posterior tooth contacts are lost, this will lead over time to neuromuscular and occluso-articular imbalances with intra- and/or extra-capsular TMJ changes.

The angle of occlusion is a fundamental concept in dentistry, illustrating the dynamic relationship between the upper and lower teeth during lateral or protrusive movements of the mandible. This insight is important for understanding occlusal dynamics, mandibular function, and preventing unwanted forces (interferences in mandibular dynamics) that could generate dental, neuromuscular, and TMJ problems.

Occlusion is the contact between the upper and lower teeth in various movements of the mandible. Occlusion is of two types: static (intercuspation - ICP) and dynamic (occlusion supporting all mandibular dynamic movements - protrusion, retrusion, left-right laterality) The disocclusion angle becomes crucial in lateral movements and protrusive movements, when decoupling from the intercuspation position. Balanced occlusion is based on a smooth disocclusion of the teeth, preventing unwanted forces that could cause premature wear, bruxism and disorders of the temporomandibular joint. An optimal angle of disocclusion is essential to prevent interference between the upper and lower teeth in functional movements, thus avoiding occlusal trauma that can affect the teeth, the supporting structures (periodontium) and the temporomandibular joint (TMJ). By facilitating a smooth disocclusion, the risk of occlusal trauma is minimized, contributing to the durability of dental restorations and the overall health of the oral cavity. In prosthetic treatments, the angle of disocclusion is considered both in simple cases and in cases of malocclusion and misalignment. Prosthodontists aim to correct occlusal discrepancies to ensure a harmonious static and dynamic occlusion of the teeth during functional movements, and addressing issues related to the angle of disocclusion contributes to improved occlusal function and general oral health in the medium and long term.

The second chapter of this thesis consists of a number of three large sections. This chapter begins with a section dedicated to dental implants. From the point of view of the history of dental implants, we know that more than 50 years ago, modern implantology was born when Dr. P.I. Brånemark, from the University of Gothenburg, noticed that titanium implants placed in the fibula became firmly anchored in the implanted bone and could not be removed. This direct bone-implant anchoring was later called "osseointegration". Dr. Brånemark demonstrated that titanium integrates structurally into bone with high predictability and no long-term inflammation or device rejection. In 1965, he introduced the pure titanium implant in the form of a two-stage threaded root, marking the beginning of modern dental implantology and thus being recognized as a pioneer in the field. Over the past decade, progress in dental implantology has included the development of strategies designed to provide long-term stability with optimal functional and esthetic results and to minimize complications. Technological advances, such as cone beam computed tomography (CBCT), have revolutionized oral surgery through the accurate assessment of bone supply and the possibility of planning interventions by correctly choosing the dimensions of the implant to be fixed in the bone, thus increasing the predictability of surgical interventions and the success of the final results. Devices that allow objective examination of implant stability through the use of resonance frequency analysis have represented a significant improvement in the quality of treatment provided to patients. These advances indicate a continued evolution in the field of implantology, with an emphasis on diagnostic accuracy and surgical and therapeutic efficacy.

Also, in the first section of this chapter, we also briefly discussed the process of osseointegration, and in this sense, we conclude that osseointegration is characterized as a direct structural and functional connection between living bone and the surface of a load-bearing implant. The cellular response to implantation is influenced by the characteristics of the implant surface, stability and thermal damage of the host bone. The process of bone healing around implants involves a series of complex biological events, similar to fracture healing. It starts with the contact of blood and blood cells, which are activated and release cytokines and growth factors around the implant. Platelets undergo biochemical and morphological changes, inducing the formation of a fibrin matrix that regulates cell adhesion and mineral binding. The ability of the implant surface to maintain fibrin attachment is crucial in determining the success of cell migration in this initial phase of the healing process.

In the second section of this chapter, the specialized literature on the typology of dental implants was studied. In this regard, it has been observed that dental implants are selected based on several criteria, including material, shape, surface, length and diameter. Common materials include pure titanium and titanium alloys for biocompatibility and corrosion resistance. Zirconium implants, considered "ceramics", have high biocompatibility. The shape of the implants varies between screws and cylindrical/conical, and implants with internal or external connection allow adaptation to various sizes. Surfaces can be smooth or textured, with hydrophilic and hydrophobic options. The length and diameter of the implants are classified into categories from extra-short to long and from very narrow to wide. These variables allow dental treatments to be customized to fit the specific needs of each patient.

In what follows, I have chosen to discuss an extremely important tool used in dental rehabilitation, namely the articulator. The dental articulator is an essential tool in dentistry, having a crucial role in the manufacture of dental prostheses and restorations. Designed to simulate the movements of the temporomandibular joint and reproduce the dynamic functions of the mandible, this sophisticated mechanical device makes it easier for dental professionals, especially prosthodontists, implantologists and dental technicians, to achieve accurate and realistic occlusion in the creation of medical devices such as crowns, bridges and dentures.

Regarding the classification of articulators, the literature in the field shows that over time, various types of articulators used in dentistry have been developed. Working casts are obtained by casting plaster impressions and fixed in the intercuspidal position (ICP). There are simple hinged articulators, verticulators, mid-value articulators, semi-adjustable articulators, fully adjustable articulators, stereographic or fossa cast articulators, and virtual articulators. Semi-adjustable articulators are most commonly used in restorative treatments. The fully adjustable articulators are sophisticated, allowing a wide range of adjustments to accurately simulate the patient's actual jaw movements. Fully adjustable articulators are those that exactly reproduce the situation in the oral cavity after being programmed. They are most indicated for implant prosthetic treatment plans and to ensure the medium and long-term success of prosthetic treatment. Stereographic articulators are customized to reproduce the exact movement of the patient's jaw. Virtual articulators, based on computer technology, were introduced as alternatives to conventional mechanical ones, being highly accurate and reliable.

The dental articulator serves as a bridge between diagnostic information and treatment planning, allowing analysis and accurate reproduction of mandibular movements after being programmed posteriorly and anteriorly. Programming parameters are obtained from condylography, these being posterior SCI/Bennett angles/ISS/SA and anterior capsule programming, which supports mandibular dynamics. The fully programmable articulator is a mathematical system that transfers the position of the upper model and the lower model, using the facebow and information obtained from condylography. Articulators can be classic (analog) and virtual. In analog articulators we use plaster or printed models. In the virtual articulator we transfer the intraoral scans of the maxilla and mandible together with the scanned static and dynamic occlusions. Like analog articulators, virtual ones are programmed with parameters obtained from condylography (posterior parameters and anterior programming). Digital impressions and the virtual articulator use intraoral scanners and software to obtain detailed 3D images and digitally simulate the movements of the mandible. CAD/CAM technologies allow manipulation of digital models for precise virtual articulation. Working models are based on accurate bite records (occlusion) and articulators are essential tools for functional and aesthetic analysis of occlusion in centric occlusion (CO), the relationship between centric occlusion and intercuspation position (long centric or point centric) and in movements of protrusion-retrusion and laterotrusion. Interocclusal registrations use bite registration materials such as wax, silicones, or polyvinyl siloxanes. These models provide improved insight and detailed assessment of occlusion in the molar area. The use of a fully programmable articulator in the precise fitting of working models allows the simulation of mandibular movements strictly guided by occlusal anatomy, eliminating the influence of neuromuscular reflexes that can mask occlusal interferences. In restorative prosthetic procedures, models mounted in the articulator are used to make the sequential functional diagnostic wax-up, and then this wax-up is transferred to a mock-up directly in the oral cavity, this step is called the plan functional and aesthetic preprosthetic. This way of working ensures a treatment plan where, at the end, the patient will benefit from a medical device customized in terms of occlusion and aesthetics.

Articulator programming is essential in the creation of dentures, ensuring precision and customization in restorative dentistry, influencing the success and accuracy of dental restorations and minimizing the time spent on occlusal adjustments.

Finally, the last section of this chapter brings up an extremely important topic, namely the concept of condylography. Condylography, a crucial branch of dental diagnosis, is a specialized field dealing with the analysis and recording of temporomandibular joint (TMJ) movements. This discipline is essential to understanding the dynamic complexity of mandibular function and makes a significant contribution to prosthetic treatment plans as well as the diagnosis and treatment of temporomandibular disorders (TMD).

One of the important aspects of this concept is represented by the methods used in condylography, and which I believe every dental professional must know. To present these methods, we performed a bibliographic review in this field, and we were able to conclude the following: graphic tracing of mandibular movements, originally done with graph paper and pens, was an early method for visually documenting these movements, but it was limited by subjectivity and lack of precision. In contrast, kinesiography, a sophisticated diagnostic tool, uses sensors attached to the head and jaw to provide an objective and detailed analysis of jaw movements in real time. Modern technologies, such as electromagnetic and ultrasonic tracking systems, have improved accuracy and efficiency in condylography, finding valuable applications in various dental procedures. Computerized condylography uses specialized devices with sensors and receptors to record and analyze the movements of the mandible and temporomandibular joint.

Based on the above, I believe that by using condylography devices, which can range from electromagnetic and ultrasonic tracking systems to computerized condylography, dentists can accurately assess mandibular movements during functional activities. This objective approach provides essential information for planning dental treatments and restorations, having a significant impact on their success. In addition, modern condylography contributes to the improvement of dental surgical procedures, such as the placement of dental implants. Computer-aided navigation systems, which use data from condylography, enable more precise positioning of implants, reducing risks and improving outcomes.

The second part of this thesis is represented by the personal contributions, and is structured on the three approved research directions. The 3 approved research directions for this thesis are: (1) Comparative evaluation of the 2 TMJs from the point of view of mandibular dynamics; (2) The functional redesign of the tooth as a method of neuro-muscular and occluso-articular rehabilitation in implanto-prosthetic rehabilitation and the correlation of dental morphology with joint parameters; (3) Improvement of the quality of life in patients with complex oral rehabilitation performed after the inclusion of condylography in the treatment protocol.

Thus, the third chapter of this thesis presents the working hypothesis and general objectives. Implant-prosthetic oral rehabilitation methods significantly improve occluso-articular stability and neuromuscular function compared to traditional oral rehabilitation methods. Starting from this hypothesis, the general objective of the doctoral thesis was established, namely the identification of new methods of neuro-muscular and occluso-articular rehabilitation in implanto-prosthetic rehabilitation, by introducing condylography in the working protocol. At the same time, it was also desired to carry out an evaluation from the point of view of the mandibular dynamics of different groups of patients, as well as how the inclusion of condylography in the treatment protocol leads to an improvement in the quality of life of the patients. Also, a series of secondary objectives were established, such as: (a) Evaluation of occlusal-articular stability in patients undergoing implanto-prosthetic oral rehabilitation; (b) Investigating the neuromuscular function of patients undergoing implanto-prosthetic oral rehabilitation; (c) Evaluation of long-term stability of occluso-articular and neuromuscular results in implanto-prosthetic oral rehabilitation methods; (d) Measuring the level of satisfaction of patients with the occluso-articular and neuromuscular results obtained through implanto-prosthetic oral rehabilitation; (e) Identification of functional improvements of the stomatognathic system: breathing, mastication, speech, swallowing, aesthetics, stress management.

The fourth chapter of the doctoral thesis considers the presentation of the general methodology of the research. In order to achieve this thesis, a group of 140 patients was used, having neuromuscular imbalances without intracapsular imbalances; subjects showing neuromuscular and intracapsular changes and occluso-articular imbalances and subjects without TMJ problems (no neuromuscular and occluso-articular imbalances). In order to obtain the most relevant data, a series of criteria for inclusion in the study, as well as criteria for exclusion from the study, were established. Thus, the criteria for inclusion in the study were the following: (a) Patients aged over 18 years; (b) Patients who agreed to participate in the study and who signed an informed consent form; (c) Patients who have not benefited from previous orthodontic treatments or craniofacial surgery; (d) Patients with complete dentition or who have been partially edentulous with a stable intercuspation position; (e) Patients showing persistence of natural/restored anterior teeth at least up to the mandibular first premolar; (f) Patients who required a cone beam computed tomography (CBCT) investigation for orthodontic treatment or insertion of dental implants. At the same time, the exclusion criteria from the study were: (a) Patients under the age of 18; (b) Patients who had limited mouth opening; (c) Patients with a history of Parkinson's disease (which would make it impossible to perform a CBCT or accurate condylography); (d) Patients with severe systemic disease; (e) Patients undergoing pharmacological therapy with drugs that could have affected their psycho-physical condition; (f) Patients presenting with acute TMJ pain.

Regarding the working methodology, the study focuses on lateral and bilateral edentulous cases, either maxillary or bimaxillary. The study subjects underwent clinical examinations and were evaluated regarding their oral health status. The research methodology includes clinical examination of the oral cavity, radiological examination, assessment of centric occlusion compared to maximum intercuspation, analysis of the six functions of the stomatognathic system and the application of a questionnaire on patients' symptoms.

From the point of view of the statistical processing method, SPSS software was used, its following functions being used: mean, median, standard deviation, frequency tables, association tables, Chi-Square test, various statistical tests, T -Test, Anova, Mann-Whitney Test, Kruskal-Wallis Test, calculation of correlation coefficients. In order to interpret p, the following were established: $p<0.05$, the statistical link is significant (S, 95% confidence); $p<0.01$, the statistical relationship is significant (S, 99% confidence); $p<0.001$, the statistical link is highly significant (HS, confidence 99.9%); $p>0.05$, the statistical relationship is not significant (NS). At the same time, for graphical representation, the following were used: bar graphs, boxplot graphs, scatter graphs and pie graphs.

Chapter 5 of this had in mind the realization of a study regarding the comparative evaluation from the point of view of mandibular dynamics. This was a dual study, as in the first phase left-right intraindividual differences in sagittal condylar inclination (SCI) were analyzed in different skeletal classes; and in the second phase, a condylographic study of the variations of the Benett angle and its importance in natural and implant restorations was carried out.

Regarding the analysis of left-right intraindividual differences in sagittal condylar inclination (SCI) in different skeletal classes, the aim of the study was to investigate from the point of view of mandibular dynamics the two TMJs, as well as to determine which factors leading to imbalances in mandibular dynamics. Inclusion criteria were: (1) age > 18 years, (2) agreeing to participate in this study and signing the informed consent form, (3) no previous orthodontic treatment or craniofacial surgery, (4) patients with complete dentition or who were partially edentulous with a stable maximum intercuspid position (MIC), (5) persistence of natural/restored anterior teeth at least up to the mandibular first premolar, and (6) the need for a cone beam computed tomography (CBCT) investigation for orthodontic treatment or insertion of dental implants.

The exclusion criteria were: (1) limited opening of the mouth, (2) history of Parkinson's disease (which makes it impossible to perform an accurate CBCT or condylography), (3) severe systemic diseases, (4) undergoing pharmacological therapy with drugs that could have affected their psycho-physical condition or (5) acute TMJ pain.

Collected data were entered into an Excel document and analyzed with IBM® SPSS® statistical software, v25.0 (IBM Corp., Armonk, NY, USA). The analysis included a descriptive assessment of numerical values, calculation of mean and standard deviation (SD). Left and right measured SCI values were tested for normal distribution (using the Shapiro-Wilk test) and then subjected to parametric tests, with significance set at $p < 0.05$. The paired t-test was used to compare the mean differences between pairs, and the t-test was used to compare the mean SCI values according to different factors such as sex, age, dental status, TMJ dysfunction, and parafunctional habits. One-way ANOVA with Bonferroni correction was used to identify statistically significant differences in mean SCI values by skeletal class. Sample size calculation was performed according to previous studies (Das et al., 2021) using G*Power, indicating a power of 0.85 for a sample size of 130 individuals at a type 1 error probability (α) of 0.05.

The recording of joint parameters such as SCI, Bennett angle and immediate lateral displacement (ISS) is the essential first step in the analysis and planning of oral rehabilitation, considering the maintenance and restoration of crucial functions such as mastication, speech, swallowing and esthetics. Among these parameters, SCI, defined as the angle between the protruding condylar track and the Frankfort plane or other horizontal reference planes, exerts a significant influence on the dynamic morphology of the teeth. Individual determination of the SCI value contributes to more accurate diagnosis, treatment planning and prosthetic restoration, saving clinical time by avoiding occlusal interference adjustments.

Our study focused on recording SCI for right and left TMJ in different skeletal classes, based on the ANB angle, to examine similarities and possible significant differences according to sex, skeletal class, dental status, TMJ disorders, and parafunctional habits. I used Camper's plane as a reference, with an angle between 9° and 15°. The mean values for right and left SCI were 34.68° and 34.94°, respectively, lower than those reported in another study, where condylar tracks divided into three sequences were used to calculate SCI. However, the mean differences between left and right SCI in our study were similar to those reported in that previous study. The mean value for skeletal class I in our group was slightly lower, perhaps due to the use of the ANB angle instead of Angle's dental classification.

In this study, no predominance of higher SCI values was observed for the right or left TMJ. The difference was calculated as an absolute value: [SCI_R–SCI_L] = [(SCI_R–SCI_L)) if SCI_R > SCI_L] or [(SCI_L–SCI_R) if SCI_R < SCI_L]. More than half of the participants (57%) had a difference of 5° or less between the right and left SCI, considered normal, but 13% had a difference of more than 10° between the right and left TMJ, with a maximum value of 26.1° for a bone class II patient. The study revealed that the differences between left and right SCI values were not statistically significant, a result consistent with another research.

No statistically significant differences were observed between left and right SCI when patient gender was taken into account. This lack of significance could be attributed to the larger number of female (n = 100) compared to male (n = 60) patients enrolled, representing one of the limitations of the study. Despite the absence of statistical significance, in general, it was observed that mean left and right SCI were higher in men than in women: SCI_L 36.89 (±12.67) vs. 34.16 (±13.43) and SCI_R 37.68 (±12.23) vs. 33.48 (±12.37).

Analyzing right and left SCI according to skeletal class, statistically significant differences were observed for left SCI between class III vs. class I and class III vs. class II. Lower mean SCI values were also recorded for class III for both right and left SCI, although without statistical significance for right SCI. Class III subjects presented the lowest mean SCI compared to those in classes I and II. Dental status also had an impact on mean SCI for both left and right sides, with a statistically significant difference observed for mean right SCI. Fully edentulous participants had lower mean SCI values for both slopes compared to partially edentulous participants. This difference may be attributed to the enrollment protocol, where fully edentulous participants sought orthodontic treatment and partially edentulous participants sought dental restorations. However, this finding was influenced by the fact that the CBCT scans used to diagnose the skeletal class were mainly performed for planning future treatments, such as the insertion of orthodontic or dental implants, thus limiting the diversity of the skeletal class in fully dentate participants, who were mainly from classes II and III.

Like any other study, this one had some limitations. First, the participant groups were not homogeneous, with more women (n = 100) than men (n = 40), reflecting the preponderance of female patients seeking dental services, particularly for aesthetic reasons, in our country. In addition, a higher number of participants was found in class II (n = 92) compared to class I (n = 39) and class III (n = 9). Enrollment of patients in this study was guided by treatment needs, thus explaining the higher percentage of fully dentate patients (75%) and the predominance of skeletal anomalies in class II and class III (total 72% of subjects).

The aim of our investigation was to analyze SCI for both the left and right TMJ and to assess the correctness of using an average value for both temporomandibular joints in the processes of diagnosis, treatment planning and fabrication of fixed or removable restorations. The results of our research revealed significant diversity both between individuals and within the same individual in terms of SCI values. This finding underlines the need for individual TMJ parameter recording to ensure personalized treatment.

As mentioned previously, this study was a dual one. Thus, the second part of the study aimed to evaluate the exact patient-specific values of the Bennett angle in a real setting, in a large group of patients, to compare the values obtained with a precise measuring device with the average values used in the dental office.

In this sense, a cross-sectional study was carried out in patients who required prosthetic treatments and who attended a private dental clinic over a period of two years. Bilateral Bennett angle measurements were performed for each individual patient, following the following protocol: patient preparation and condylography.

Regarding patient preparation, in the first phase, we made impressions of the upper and lower arch using a polyvinylsiloxane material (President Coltene/Whaledent AG) and a dental occupation record with LuxaBite from DMG. Next, we performed a facial arch position determination using the ARCUSevo face arch from KaVo Dental GmbH. This information was then used to fit the maxillary model within the mathematical system of the PROTARevo 7 articulator from KaVo Dental GmbH, which was used to prepare the mandible for dynamic recordings. The initial impressions were sent to the dental laboratory to make working models, using class IV plaster (Shera Premium, Shera Werkstoff-Technologie). The bite registration was carefully checked to remove any thinning that could affect the correct seating of the models in occlusion. The check was performed on the most distal occlusal cusps and grooves, usually on the molars and on the upper and lower incisal group on the incisal planes. The purpose of this check was to ensure that there is no gap between the tooth contour and the occlusal contour of the occlusion silicone. This fit check procedure was performed left-right for each individual model.

The condylography performed involved the recording of dynamic movements of the mandible, including protrusion, retrusion, left laterotrusion, and right laterotrusion. For each dynamic movement, three consecutive recordings were made and the KaVo KiD software calculated the average of the corresponding 3 values. During this process, 4 parameters were calculated for each side of the mandible: sagittal inclination of the condyles (SCI); the Bennett angle; immediate lateral displacement (ISS); the displacement angle (SA).

Categorical variables were reported as absolute and relative frequencies. For continuous variables, which had a non-parametric distribution, confirmed by the Shapiro Wilk test, the median and interquartile range (IQR) were used. Analysis of the correlation between two independent continuous variables included the results of the Spearman rank order correlation test. When two paired continuous variables were compared, the Wilcoxon signed-rank test was used. The Mann-Whitney U test was used for the comparison of continuous variables between two groups of a categorical variable, while the Kruskal-Wallis H test was applied for the comparison of continuous variables in three or more groups of a categorical variable. All tests were two-tailed, and the level of statistical significance was set at $p<0.05$.

Overall, we found that the median Bennett angle was 6.7° in our patient population, with 50% of the values placed in the interquartile range (IQR) between 4.0° and 12.5°. The absence of a direct correlation between the values measured on the right and left suggests the need to consider each temporomandibular joint as a separate anatomic-functional unit in the planning of prosthetic treatment. Age and skeletal class were not identified as significant predictors of Bennett angle values. Although there was a median difference of 1.6°, with greater Bennett angles on the right, no statistically significant pattern was identified. The main significant result of the study was the association of male gender with higher Bennett angle values, both overall ($p<0.001$) and at each measurement site ($p=0.001$ each). We also observed a wide variety of Bennett angle values, with significant left/right differences in the patient population. Consequently, we conclude that each case must be treated individually in measurements for prosthetic rehabilitation, in order to obtain the best functional results. Based on the results, a more appropriate average value for the Bennett angle would be 10° for male patients and between 7-8° for female patients.

In order to complete the sixth chapter of this doctoral thesis, I researched and introduced condylography in implanto-prosthetic rehabilitation methods, resulting in a study on the correlation of dental morphology with joint parameters. The purpose of this research was to investigate ways to rehabilitate joint and neuromuscular function in the context of implant-prosthetic treatment, with an emphasis on the use of condylography to evaluate and improve the final results of treatment. By introducing and using condylography as a diagnostic tool in the rehabilitation methods of joint and muscle function in implanto-prosthetic treatment, we have identified two distinct prosthetic approaches, one of which is divided into two subdivisions. The first method of occluso-articular and neuro-muscular rehabilitation in implant rehabilitation we defined as "Functional redesign of the K tooth" having as its basic construction the kinematic axis, which the Arcus Digma condylograph locates and records during the condylography. The functional redesign of the K tooth has two subdivisions, K1 and K2. Subdivision K1 is used for cases where we need to reposition the mandible in a new therapeutic position by changing the vertical dimension of occlusion (DVO). Subdivision K2 is used for cases where we want to preserve the vertical dimension of occlusion and perform functional implanto-prosthetic rehabilitations on implants. The functionality is given by the neuromuscular and occluso-articular balance of the rehabilitations. The second method of occluso-articular and neuro-muscular rehabilitation in implant rehabilitation we defined as "Functional redesign of the R tooth" having as its basic construction the rotation at the level of the mandibular condyles and the hinge axis. We use this method when we reposition the mandible in a new therapeutic position and also change the vertical dimension of occlusion. Implanto-prosthetic rehabilitation methods are exemplified by means of clinical situations, where the working stages of each method are in-depth.

Subdivision K1 is used for cases where we need to reposition the mandible in a new therapeutic position by changing the vertical dimension of occlusion (DVO). For example, I chose the clinical situation of a patient with a good general clinical condition, a smoker, who faces the following problems: mastication problems, speech, dental sensitivity, unsatisfactory aesthetics, halitosis.

Subdivision K2 is used for cases where we want to preserve the vertical dimension of occlusion and perform functional implanto-prosthetic rehabilitations on implants. The functionality is given by the neuromuscular and occluso-articular balance of the implanto-prosthetic rehabilitations, which is directly related to the occlusion plan and the morphological modeling of the implanto-prosthetic rehabilitations. For example, we have chosen a clinical situation that falls under the occluso-articular and neuromuscular rehabilitation method in the implanto-prosthetic rehabilitation "Functional redesign of the K2 tooth" where we want to preserve the vertical dimension of the initial occlusion.

The last method, "Functional Redesign of the R tooth", has as its basic construction the rotation at the level of the mandibular condyles and the hinge axis. The rotation is achieved by guiding the mandible slightly retrusively, but without forcing the condyles to press the bilaminar area, and from this retrusive position, where we identify the rotation, it is important to be able to guide the mandible more retrusively and superiorly in the temporomandibular joints. We use this method when we reposition the mandible in a new therapeutic position and also change the vertical dimension of occlusion. This rotation must be reproducible and this is confirmed during condylography. After we have identified the bilateral rotation, we will transmit this information percutaneously and then the patient is given a teleradiography. For example, we have chosen a clinical situation that falls under the occluso-articular and neuromuscular rehabilitation method in the implanto-prosthetic rehabilitation "Functional redesign of tooth R" where we want to reposition the mandible in a new therapeutic position and restore the occlusion plane and inclination to positive values.

Our study emphasized the importance of achieving a harmonious balance between implant-prosthetic restorations and temporomandibular joints (TMJs), the neuromuscular system and the occlusal plane to ensure both functional and esthetic results in implant-prosthetic treatment. We found that the integration of condylography in our methods (K1, K2, R) facilitated the achievement of these goals. Our research suggests that the placement and volume of dental implants in the maxillary and mandibular bones is not arbitrary, but is influenced by factors such as TMJ anatomy, muscle vectors, genetic information, and skeletal development.

At the same time, the seventh chapter is represented by a study on the improvement of the quality of life in patients with complex oral rehabilitation performed after the introduction of condylography in the treatment protocol. The aim of the present study was to carry out comparative research between the initial condylography and the control condylography after restoring the occlusion plane and repositioning the mandible in the new therapeutic position. The purpose of this study is to determine the influence that the introduction of condylography in the treatment protocol and neuromuscular and occluso-articular rehabilitation methods in implanto-prosthetic therapy Functional redesign of the K1, K2 and R teeth have on improving the quality of life of patients.

The study demonstrated that the use of neuro-muscular and occluso-articular methods in implanto-prosthetic therapy Functional redesign of the tooth K1, K2 and R led to a reduction in chewing difficulties and a significant improvement in teeth closure problems. The mean values of teeth closing problems showed a significant difference, with a mean decrease of 29.98 after the use of neuro-muscular and occluso-articular rehabilitation methods in implant-prosthetic therapy Functional redesign of tooth K1, K2 and R. As for regarding speech, neuro-muscular and occluso-articular rehabilitation methods in implant-prosthetic therapy Functional redesign of K1, K2 and R teeth had a positive impact and the results indicated a significant difference after treatment. Regarding tooth sensitivity, the study revealed a further decrease in sensitivity after the use of neuro-muscular and occluso-articular rehabilitation methods in implanto-prosthetic therapy Functional redesign of K1, K2 and R tooth, with an average difference of 1.23 between mean values before and after treatment. These findings suggest that neuro-muscular and occluso-articular rehabilitation methods in implant-prosthetic therapy Functional redesign of K1, K2 and R teeth had a positive and significant impact on the oral health status and quality of life of the patients involved in the study.

The study evaluated whether patients had difficulties in opening the mouth wide before and after using neuromuscular and occluso-articular rehabilitation methods in implant-prosthetic therapy Functional redesign of tooth K1, K2 and R. The results indicate a significant reduction of the problem of mouth opening after using neuro-muscular and occluso-articular rehabilitation methods in implanto-prosthetic therapy Functional redesign of K1, K2 and R teeth. Regarding jaw joint noises, only 14.3% of participants reported this problem after using neuro-muscular and occluso-articular rehabilitation methods in implanto-prosthetic therapy Functional redesign of the K1, K2 and R tooth, and only 1.25% mentioned pain in the area of the jaw joints. Thus, the use of neuro-muscular and occluso-articular rehabilitation methods in implanto-prosthetic therapy Functional redesign of K1, K2 and R teeth significantly reduced joint noises and pains. The prevalence of headaches was significantly lower after the use of neuromuscular and occluso-articular rehabilitation methods in implant-prosthetic therapy Functional redesign of K1, K2 and R tooth, indicated by a t-value of 26.06, with a mean difference of 1.23, suggesting a substantial improvement. Regarding cramps and spasms in the head and neck area, the analysis indicated a significant improvement following the use of neuro-muscular and occluso-articular rehabilitation methods in implant-prosthetic therapy Functional redesign of the tooth K1, K2 and R, highlighted of a t-value of 25.75, with a mean difference of 1.26. Overall, the results suggest that the use of neuro-muscular and occluso-articular rehabilitation methods in implant-prosthetic therapy Functional redesign of K1, K2 and R teeth had a significant positive impact on mouth opening problems, noises and joint pain, headaches, as well as cramps and spasms in the head and neck area.

Factor analysis of the domains physical pain, functional limitations and psychological discomfort using neuro-muscular and occluso-articular rehabilitation methods in implant-prosthetic therapy Functional redesign of K1, K2 and R tooth demonstrated a significant reduction in symptoms previously reported by to patients. The chi-square statistic was 53.0909 and the p-value was < 0.00001, indicating statistical significance at $p<0.05$ and supporting the fact that variables such as gender, age and education level did not influence patient satisfaction or improvement in quality of life.

The conclusions of the study highlight that the use of neuro-muscular and occluso-articular rehabilitation methods in implanto-prosthetic therapy Functional redesign of K1, K2 and R teeth contributed significantly to improving the general quality of life of the patients included in the research. The introduction of condylography into treatment protocols for temporomandibular disorders is considered a turning point in dentistry, providing increased accuracy in diagnosis, individualized treatment planning and promoting patient education. The profound impact of condylography is not only limited to the relief of symptoms, but also to the active involvement of patients in the management of their oral health. As technology advances, the synergy between condylography and evolving treatment modalities promises to continue to improve outcomes and raise standards of care for those with prosthetic-implant therapy and temporomandibular disorders.

Generally speaking, both through the study of the specialized literature and through the prism of the research carried out, it has been proven that condylography, through the dynamic recording of mandibular movements, such as protrusion, retrusion and lateral movements, provides valuable information on the dynamics of the temporomandibular joint (ATM). The ability to record these movements in three dimensions helps to gain a comprehensive understanding of joint behavior, enabling more accurate diagnoses. This accuracy is crucial for identifying the root causes of TMD and tailoring treatment plans to meet individual patient needs.

The functional redesign of the tooth (K1, K2, R) as a method of neuromuscular and occluso-articular rehabilitation in implanto-prosthetic rehabilitation is a functional prosthetic concept, which aims to integrate into the stomatognathic system the artificial volumes represented by the crowns and bridges in the treatment plan implanto-prosthetic. The concept is created to preserve the balance of mandibular dynamics and reproduce the 6 functions of speech, breathing, swallowing, mastication, stress management and aesthetics. The Functional Tooth Redesign concept (K1, K2, R) is based on condylography and the transfer of all data obtained in the dental office to the dental laboratory. Through its functionality, the Functional Tooth Redesign concept (K1, K2, R) preserves the biology and physiology of the neuromuscular system and the two temporomandibular joints (TMJs). The functional redesign of the tooth (K1, K2, R) as a method of neuromuscular and occluso-articular rehabilitation in implanto-prosthetic rehabilitation is composed of all the clinical stages of the treatment plan established and designed by the dentist and continues with the technical laboratory stages. There are two fields and complementary entities in dentistry (dental office and dental laboratory) that must ultimately deliver functional implant-prosthetic rehabilitation to the patient, because the strategy, vision and predictability of the prosthetic treatment plan in the dental clinic are indirectly continued in the dental laboratory, where the prosthetic work is carried out which in the end will ensure the neuromuscular and occluso-articular balance.

We also observed in our study that in order to achieve a predictable implant-prosthetic treatment plan, which is functional and aesthetic, it is necessary that the artificial volumes, represented by the implant-prosthetic rehabilitations, be in balance with the two TMJ, the neuromuscular system and with the occlusal plane. These goals were achieved by introducing condylography in the implanto-prosthetic rehabilitation methods described (K1, K2, R). From the two studies carried out we can draw the conclusion that the volume and implantation of the dental organ (tooth) in the maxillary and mandibular bone are not accidental. They are directly related to the anatomy of the TMJ and the vector direction of the muscles of the cranio-mandibular system, genetic information and skeletal development. If we do not have enough information related to mandibular dynamics (SCI/BENETT/ISS/SA) to be able to program the articulator on which we perform the future implant-prosthetic works and we do not register a correct DVO, then the position of the implant-prosthetic restorations on the working articulator is not corresponds to the position in the oral cavity, this situation leading to the restoration of models or even the final works. When we do not control the vertical dimension of occlusion (DVO), occlusal plane, interarch registration (to be determined in rotation and not translation) and rely too much on the dental laboratory, the final results will be non-functional and with many occlusal retouches or even restorations. That is why the dentist has a complex mission, namely he must identify a skeletal position of the mandibular bone in relation to the skull, record this position which is directly related to the neuromuscular system (represented in our case by the muscles of the cranio-mandibular system that insert on mandibular bone, hyoid bone and on the skull) and then relay this information to the dental technician. Worldwide there are numerous schools of gnathological thought that approach the strategy and way of working differently, but they all have as a common point the recording of mandibular dynamics.

There are a variety of advantages of using implanto-prosthetic rehabilitation methods based on the functional Redesign of the K1, K2 and R tooth. Among them, we mention: (a) obtaining complete information related to the anatomy of the skull and mandibular condyles by performing condylography diagnostic; (b) customized implant-prosthetic treatment plan based on the uniqueness of each case; (c) identifying TMJ imbalances and dysfunctions and establishing the therapeutic approach in patients with neuro-muscular and occluso-articular imbalances; (d) elimination of short, medium and long term risks of temporomandibular dysfunctions; (e) The ratio of the articulator obtained from condylography where we have recorded the four parameters (SCI/BENETT/ISS/SA) is the most valuable functional information for the dental laboratory to be able to program its fully programmable articulator; (f) achieving balance between the occlusion plane, the neuromuscular system and the two temporomandibular joints (TMJs); (g) redesign of the active and passive arches in the mandible and maxilla; (h) achieving both static and dynamic balanced occlusion (ICP); (i) three-dimensional functional positioning of each cusp tip and cusp slopes in dynamic mandibular functional balance; (j) the positioning and realization of the convex-concave represented by the maxillary functional space in accordance with the sagittal inclination of the condyles (SCI) and the anatomy of the articular eminence; (k) three-dimensional functional positioning of the incisal planes of the upper and lower front group at the level of implanto-prosthetic rehabilitations in functional balance with protrusion and retrusion movements; (l) interarcadic determinations are registered either in centric occlusion or in rotation and never in translation; (m) obtaining a centric point (intercuspation position corresponds to centric occlusion); (n) obtaining neuromuscular and occluso-articular balance validated by interpreting or comparing the results of the two condylographies; (o) the provisional implanto-prosthetic rehabilitations made are used to validate and analyze the neuromuscular and occluso-articular balance in the vertical dimension of occlusion (DVO); (p) the information obtained after the condylography is also transmitted to the patient, this information can also be used in the future to carry out other dental rehabilitation; (q) using any of the three methods of Functional Redesign of the tooth (K1/K2/R) we will save time and improve our work productivity in the dental office due to the fact that occlusal touch-ups are minimal or not at all at the level of final implant-prosthetic restorations; (r) Elimination of failures (redundancies) by controlling and validating each work step in the treatment plan of implanto-prosthetic rehabilitations; (s) satisfied and satisfied patients because the six functions of the stomatognathic system are restored functionally and not randomly, and the final works are customized taking into account the anatomy of the temporomandibular joints and individual mandibular dynamics; (t) improved professional doctor-dental technician collaboration due to the communication of the articulator report (SCI, Benett, ISS, SA) and all the necessary information, in order to be able to perform implanto-prosthetic restorations predictably, functionally and aesthetically.

The individualized nature of condylography data allows for treatment plans that are specifically tailored to each patient. Understanding the unique characteristics of mandibular movement, such as sagittal condylar inclination (SCI), Bennett angle, immediate lateral displacement (ISS), and shift angle (SA), allows clinicians to develop targeted interventions. Personalized treatment plans help improve efficacy, patient satisfaction, and long-term success in TMD management.

The intricate relationship between the temporomandibular joint and occlusal function plays a critical role in oral health. Condylography helps optimize occlusal relationships by providing insights into how the mandible moves during various functional activities. This information guides adjustments that improve occlusal stability, minimizing the risk of occlusal interference and malocclusion. Optimizing occlusal relationships not only promotes better oral health, but also helps prevent TMD problems.

One of the transformative aspects of condylography is its ability to visually represent mandibular movements. This visual representation facilitates patient education by allowing individuals to understand the dynamics of their own temporomandibular joint. Informed patients are more likely to actively participate in their treatment, follow post-treatment care plans, and make lifestyle adjustments that contribute to long-term oral health.

In conclusion, the integration of condylography in treatment protocols represents a paradigm shift in dentistry. The ability to accurately diagnose, customize treatment plans, optimize occlusal relationships, and educate patients about their own joint dynamics has far-reaching implications for the field. As technology continues to advance, the synergy between condylography and evolving treatment modalities promises to not only improve outcomes but also set new standards in comprehensive, patient-centered care.

REFERENCES

[1] Hosmann, R., Abbink, D. și Cardullo, F. The Neuromuscular system. AIAA Modeling and simulation Technologies Conference, p.3, 2010.

[2] Bordoni, B. și Varacallo, M. Anatomy, Head and Neck, Temporomandibular Joint. StatPearls, Treasure Island: StatPearls Publishing, p.1, 2019.

[3] Breeland, G., Aktar, A. și Patel, B.C. Anatomy, head and neck. Mandible. StatPearls [Internet], Treasure Island (FL): StatPearls Publishing, 2013.

[4] Akita, K., Sakaguchi-Kuma, T., Fukino, K. și Ono, T. Masticatory muscles and branches of mandibular nerve: positional relationship between various muscle bundles and their innervating branches. Anatomical Records (Hoboken), 302(4):609-619, 2019.

[5] Zohrabian, V.M., Poon și C.S., Abrahams, J.J. Embryology and Anatomy of the Jaw and Dentition. Seminars in Ultrasound, CT and MRI, 36(5):397-406, 2015.

[6] Kong, H.J. și Oh, S.C. Evaluation of Bonwill triangle using cone beam computerized tomography in Korean. Journal of Dental Rehabilitation and Applied Science, 34:97–103, 2018.

[7] Veli, I., Ozturk, M.A. și Uysal, T. Curve of Spee and its relationship to vertical eruption of teeth among different malocclusion groups. American Journal of Orthodontics and Dentofacial Orthopedics, 147(3):305-312, 2015.

[8] Nelson, S.J. Wheeler's dental anatomy, physiology and occlusion e-book. În: Elsevier Health Sciences, 2014.

[9] Davies, S. și Gray, R.M. What is occlusion? British Dental Journal, 191(5):235-238, 2001.

[10] Tripton, P. Restoration fundamentals. În: Scottish Dental Magazine, 2013.

[11] Buser, D., Sennerby, L. și De Bruyn, H. Modern implant dentistry based on osseointegration: 50 years of progress, current trends and open questions. Periodontology 2000, 73(1):7-21, 2017.

[12] Mavrogenis, A.F., Dimitriou, R., Parvizi, J. și Babis, G.C. Biology of implant osseointegration. Journal of Musculoskeletal and Neuronal Interactions: JMNI, 9(2):61–71, 2009.

[13] Krishnamurthy, B., Elavenil, P., Suvy, M., Vinay, V.K. și Anshui, R. Oral and Maxillofacial Surgery for the clinician, Springer, p.1345, 2021.

[14] Le Guehennec, L., Soueidan, A., Layrolle, P. și Amouriq, Y. Surface treatments of titanium dental implants for rapid osseointegration. Dental Materials, 23:844–54, 2007.

[15] Lang, N.P., Salvi, G.E., Huynh-Ba, G., Ivanovski, S., Donos, N. și Bosshardt, D.D. Early osseointegration to hydrophilic and hydrophobic implant surfaces in humans. Clinical Oral Implants Research, 22(4):349–56, 2011.

[16] Okeson, J.P. Management of temporomandibular disorders and occlusion (8th Edition). St. Louis, Mo: Mosby, p.442, 2019.

[17] Zaghlan, R.A., Aqrabawi, J., Al-Fatyan, O. și Zaghllan, B.A. Dental articulators. Journal of International Dental and Medical Research, 14(4):1629, 2021.

[18] Azer, S.S. și Kemper, E. The patient-specific anatomical articulator. The Journal of Prosthetic Dentistry. Published online, 2021.

[19] Rosenstiel, S.F., Land, M.F. și Fujimoto, J. Contemporary fixed prosthodontics (5th Edition). St. Louis, Mo: Mosby Elsevier, p.42, 2016.

[20] Lepidi, G., Galli, M., Mastrangelor, F., Galli, M., Mastrangelo, F., Venezia, P., Joda, T., Wang, H.L. și Li, J. Virtual articulators and virtual mounting procedures: where do we stand? Journal of Prosthodontics, 30(1):26, 2021.

[21] Maestre-Ferrín, L., Romero-Millán, J., Peñarrocha-Oltra, D. și Peñarrocha-Diago M. Virtual articulator for the analysis of dental occlusion: an update. Medicina oral, patologia oral y cirugia bucal, 17(1):161, 2012.

[22] Yau, H.T., Liao, S.W. și Chang, C.H. Modeling of digital dental articulator and its accuracy verification using optical measurement. Computer Methods and Programs in Biomedicine, 196:105646, 2020.

[23] Saoji, S. și Bhoyar, A. Programming of articulators (1st Edition). LAP Lambert Publishing, p.71, 2014.

[24] Mantout, B., Giraudeau, A., Perez, C., Re, R.P. și Orthlieb, J.D. Technical validation of a computerized condylographic system. International Journal of Stomatology & Occlusion Medicine, 1(1):46, 2008.

[25] Zhao, H., Lan, T., Xiang, B., Li, Z. și Liu, Y. Features of condylography curves. 35(5):556, 2017.

[26] Casazza, E., Re, J.P., Giraudeau, A., Parfu, A. și Orthlieb, J.D. Dental occlusion: proposal for a classification to guide occlusal analysis and optimize research protocols. The Journal of Contemporary Dental Practice, 22(7):841, 2021.

[27] Ahlers, M.O., Bernhardt, O., Jakstat, H.A. și Kordass, B. Motion analysis of the mandible: guidelines for standardized analysis of computer-assisted recording of condylar movements. International Journal of Computerized Dentistry, 18(3):202, 2015.

LIST OF PUBLISHED SCIENTIFIC WORKS

Drăguș, A.C., Augustin, M., Tănase, G. și Mițariu, M. Clinical study of analysis of deviation from the mean of Bennett angles using electronic condylography measurement. Medicine in evolution, Vol. XXVIII, No. 4, 2022.

Drăguș, A.C., Augustin, M., Tănase, G., Mițariu, M., Drăguș, I.A. Redesign-ul funcțional al dintelui (FTR). SEA – Practical Application of Science, 2022, Vol. X, Issue 30:167-170. https://spas.seaopenresearch.eu/volume-x

Drăguș, A.C., Augustin, M., Tănase, G., Burlibașa, M. și Cristache, C.M. Intraindividual Left-Right Side Differences of Sagittal Condylar Inclination (SCI) in Different Skeletal Classes. Healthcare, 2023, 11:1-13. Capitolul 5, paginile 36-45.

https://www.mdpi.com/2227-9032/11/9/1341?utm_campaign=releaseissue_healthcareutm_medium=emailutm_source=releaseissueutm_term=titlelink6

Drăguș, A.C. Săndulescu, M., Popovici, I.A., Mițariu, M.I., Augustin, M. și Vasca, E.M. A condylographic study of variations of the bennett angle and its importance in natural teeth- and implant-supported restorations. Romanian Journal of Oral Rehabilitation, 2023, 15(4):48-55. Capitolul 5, paginile 49-56. https://rjor.ro/a-condylographic-study-of-variations-of-the-bennett-angle-and-its-importance-in-natural-teeth-and-implant-supported-restorations/