MEDICINE AND MATERIALS

Volume 3, Issue 1, 2023: 3-12 | ISSN: 2784 – 1499 & e-ISSN: 2784 – 1537
DOI: 10.36868/MEDMATER.2023.03.01.003 | www.medicineandmaterials.com |

CONE BEAM COMPUTED TOMOGRAPHY, IMPORTANCE OF EXAMINATION FOR THE STORAGE OF THERAPEUTICAL FAILURES IN IMPLANTOLOGY

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Abstract

CBCT (Cone Beam Computed Tomography) plays a crucial role in implantology, offering significant advantages over traditional two-dimensional imaging techniques, such as X-rays. Here are some of the important benefits of CBCT in implantology. Precise three-dimensional imaging: CBCT provides high-resolution three-dimensional images of the patient's oral and maxillofacial region. This allows a comprehensive assessment of anatomical structures, including bone volume, quality, and density. Precise evaluation of these factors is crucial for successful implant placement. In the analysis of CBCTs, we followed all the parameters of the hard tissues, and depending on them we opted for the insertion of the implants, ensuring their predictability post-resort through rigorous management of each clinical case. Using CBCT, the bone supply at the level of each implant site was examined, corresponding to each tooth at the jaw and mandibular level, subsequently performing a computerized simulation of implant positioning in relation to neighborhood anatomical formations, taking into account the indications of subsequent prosthetic rehabilitation, including as long as clinical cases have allowed patients' aesthetic desires. The CBCT-type investigation is indispensable for complex and complete implantology oral rehabilitation for each clinical case, taking into account, as far as possible, the guided insertion of implants from a prosthetic point of view.

Keywords*: dental implant; implantology; CBCT; oral rehabilitation.*

Introduction

Since ancient times, people have been concerned with replacing lost teeth using various materials such as bovine bone, ivory, shell pieces, stone, human teeth, then various metals, all processed and adapted in various forms with the idea of restoring the functions of the dentomaxillary apparatus and facial aesthetics [1].

Computer tomography (CT) has been widely used in dentistry and implantology for many years. Conical computed tomography (CBCT) is a specialized type of CT imaging that has gained significant popularity and recognition in the field of implantology. CBCT provides high-resolution three-dimensional images of the maxillofacial region with relatively low radiation exposure compared to conventional CT scans [1,2].

The history of CBCT in implantology can be traced until the end of the 1990s when the first CBCT scanners designed specifically for dental applications were introduced. These

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scanners used a cone-shaped X-ray beam, which rotates around the patient's head, capturing a series of two-dimensional images from different angles. These images are then reconstructed using specialized software to generate a three-dimensional representation of the patient's anatomy [1-3]. CBCT quickly became an invaluable tool in implantology due to its ability to provide detailed anatomical information. Allows accurate assessment of bone volume, density, and quality, as well as visualization of important anatomical structures such as adjacent nerves, sinuses, and teeth. This information is crucial for treatment planning, implant placement, and assessment of potential complications [3,4].

Over the years, CBCT technology has evolved, with improvements in image quality, resolution, and scanning times. Newer CBCT scanners provide higher spatial resolution, reduced radiation exposure, and improved software capabilities for image analysis and implant planning [4,5].

CBCT's integration into implantology has revolutionized the way dental implants are planned and placed. With CBCT imaging, clinicians can accurately assess the patient's bone volume and quality, select the size and ideal position of the implant, and avoid vital structures, reducing the risk of complications during surgery. It also allows virtual implant placement and surgical guidance, which further improves the accuracy and predictability of implant treatment [6].

In conclusion, CBCT played a significant role in the progress of implantology. Its ability to provide detailed three-dimensional images of the maxillofacial region has improved treatment outcomes, increased patient safety, and facilitated the success of dental implant procedures [4-7].

The concept of endosseous implants currently used is that of Dr. P. Branemark (1978), made of titanium alloy, initially in cylindrical form, later transonic, being the most predictable and well-documented implants to date. With these, the concept of osteointegration appeared and the principles demonstrated by it are still valid today, namely the granting of a period (6 months), to produce the structural and functional connection between the bone and the surface of the implant [1,8].

The evolution of radiology allowed a better understanding and predictability of implantology treatments, through the possibility of rigorous documentation of clinical cases, planning, and simulation of results, all of which were easy using CBCT scanning [8,9].

We currently enjoy the benefits of CBCT, whenever conventional X-rays do not provide enough information about bone supply, of course, used justified according to the particularity of each clinical case, together with a solid clinical examination based on the general conditions and the history of loco-regional diseases. CBCT documentation must be performed by opting for the smallest scan area that provides the maximum available information [10,11].

In choosing the theme „ The need to examine Cone Beam Computed Tomography to reduce therapeutic failure in implantology ”, we were determined by several factors such as:

- Interest in this subject in my current and future professional activity and the desire to accumulate and deepen as much information as possible regarding the use of CBCT in implant-prosthetic treatment [9-12].

- The desire to avoid possible accidents and complications that may occur as a result of surgical implant insertion workmansions [9-12].

- The desire to reduce the rate of implant-prothetic failure due to insufficient study of the clinical case [9-12].

- Concern for the predictability of treatments and the maintenance of implants on the arch for as long as possible [9-12].

- Increased interest in the most efficient and reasonable therapeutic solutions, depending on the particularities of each case [9-12].

a principle of conservation – which would not have been taken into account in classical alternatives – conventional prosthetic works [9-13].

The answer to the growing interest of patients in implant-protein treatments;

CBCT (Cone Beam Computed Tomography) plays a crucial role in implantology, offering significant advantages over traditional two-dimensional imaging techniques, such as X-rays. Here are some of the important benefits of CBCT in implantology:

Precise three-dimensional imaging: CBCT provides high-resolution three-dimensional images of the patient's oral and maxillofacial region. This allows a comprehensive assessment of anatomical structures, including bone volume, quality, and density. Precise evaluation of these factors is crucial for successful implant placement [12-16].

Precise implant planning: CBCT images allow the implantologist to accurately plan the placement of dental implants. They can evaluate the available bone volume, identify vital structures (such as nerves or sinuses) and select the optimal size, length, and angulation of the implant. This information helps to avoid complications during the surgical procedure [12-14].

Bone quality and density assessment: CBCT allows for a detailed analysis of bone quality and density, which are important factors for the long-term success of dental implants. By evaluating these parameters, the implantologist can determine if additional procedures, such as bone graft or sinus lifting, are required to achieve optimal implant stability [14-16].

Detection of anatomical variations: CBCT images provide a clear view of anatomical variations, such as the shape and position of the jaw bone, mandibular duct, and maxillary sinus. Identifying these variations helps the implantologist to accurately plan the implant placement and avoid potential complications [12-16].

Evaluation of adjacent structures: CBCT can assess the relationship between teeth, roots, and adjacent structures. Helps identify pathologies such as cysts, tumors, or infections that could affect the implant treatment plan. In addition, it helps to diagnose and assess disorders of the temporomandibular joint or other conditions that may affect the overall success of the implant procedure [14-16].

Improved patient communication: CBCT images provide visual representations that can be easily understood by patients. Implantologists can use these images to explain the treatment plan, show the expected results, and answer any concerns or questions the patient may have. This promotes informed decision-making and improves patient satisfaction [12-16].

It is important to note that CBCT imaging should be used judiciously, given the associated radiation exposure. Benefits and risks should be weighed carefully and appropriate clinical guidelines and protocols should be followed to ensure patient safety [16-18].

Materials and methods

This study was performed on a group of 130 patients of their own dental office, who recorded their agreement on the collection, processing, and use of used medical information to carry out this work.

Participants in this study are patients who have had indentations of at least 6 months, due to various, traumatic, or periodontal diseases.

Patients requiring implant-prosthetic treatment, aged between 25 and 72 years, were included in the chosen group. I asked all patients for CBCT paraclinical examination.

Using CBCT, the bone supply at the level of each implant site was examined, corresponding to each tooth at the jaw and mandibular level, subsequently performing a computerized simulation of implant positioning about neighborhood anatomical formations, taking into account the indications of subsequent prosthetic rehabilitation, including as long as clinical cases have allowed patients' aesthetic desires.

Results and discussion

Of the total number of patients who were addressed for the implantology rehabilitation of edentated arches, with at least one edentation, a percentage of 57% was represented by male patients and 43% by females. (Fig. 1)

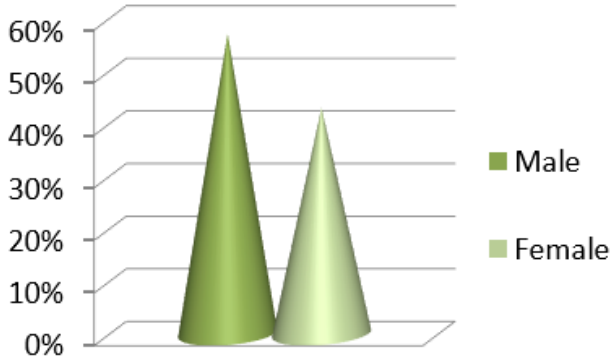

Fig. 1. Percentage distribution by sex.

Analyzing the number of patients with at least one edentation, there is an increase in the frequency of indentations with age. (Fig. 2)

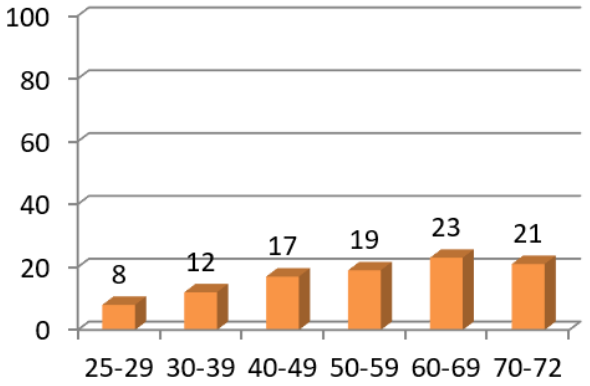

Fig. 2. Distribution of patients edentation by age groups (patients with at least one edentation)

Following the analysis of the patients in the study group, there is an increase in the number of absent dental units, compared to their age. (Fig. 3)

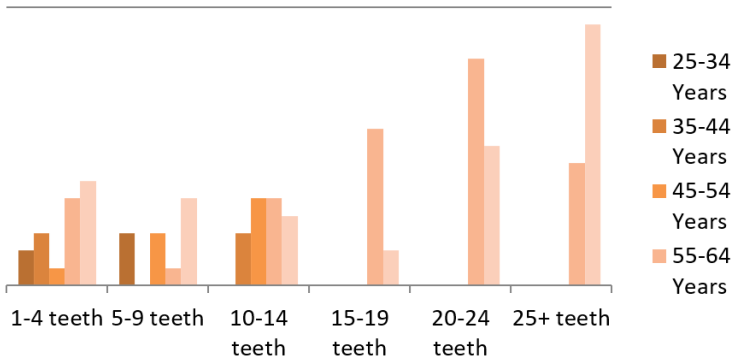

Fig. 3. Distribution of absent teeth by age

Following the CBCT analysis, the mean bone height at the jaw level, the correspondence of each absent tooth was calculated. (Fig. 4)

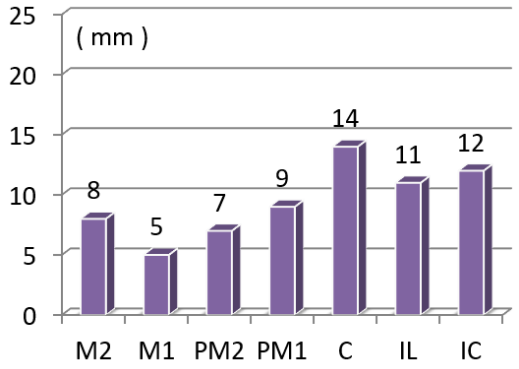

Fig. 4. Mean bone height of the ridge edentate to the jaw (maxillary bone height)

After the CBCT scan, the mean bone height at the mandibular level was calculated, with correspondence for each tooth absent (Fig. 5).

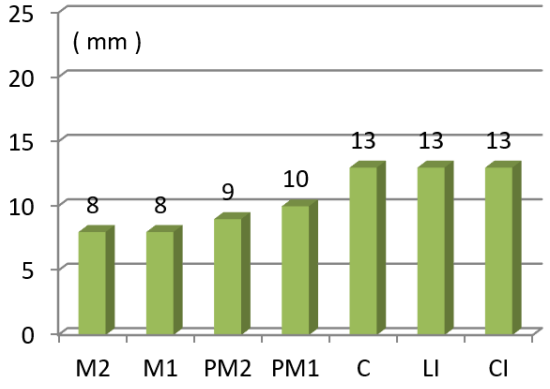

Fig. 5. Average bone height of the edented ridge at the mandibular level (mandibular bone height)

Using the virtual ruler in the CBCT analysis software, the average width of the ridge at the jaw level was calculated, depending on the positioning of the edentation (Fig .6).

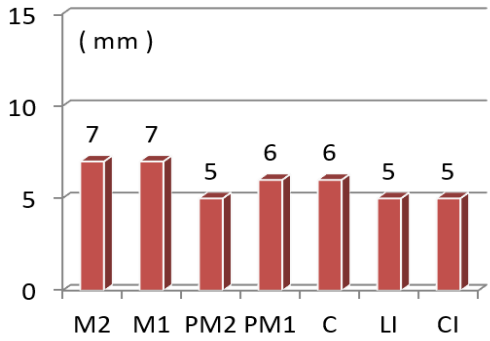

Fig. 6. The average width of the edentity ridge at the jaw level (maxillary bone width)

Following the CBCT analysis of the frontal maxillary edited ridges, the presence in 31% of cases was detected, and the absence in 69% of cases of the super-coronary concavity of the vestibular board. (Fig. 7)

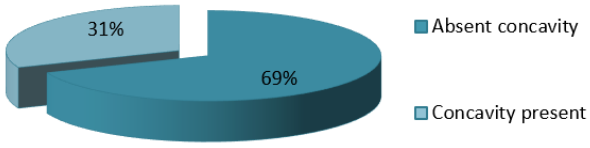

Fig. 7. The CBCT analysis of the frontal maxillary edited ridges.

Through the study of CBCT scans of patients in the study group, bone density at the jaw level in the frontal area could be determined. (Fig. 8)

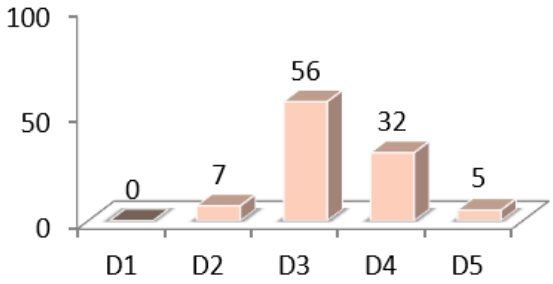

Fig. 8. Bone density at the jaw level, frontal area

Measurement of bone density at the jaw level in the lateral area could be performed using CBCT software (Fig. 9).

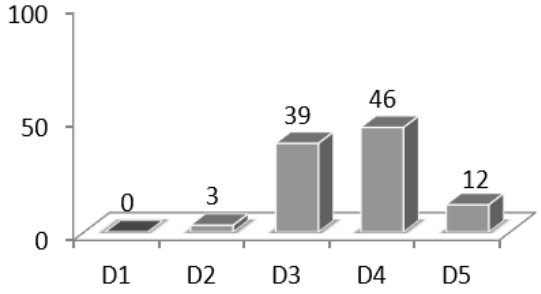

Fig. 9. Bone density at the jaw level, lateral area

Following the Cone Beam CT analysis, bone density at the mandibular level in the frontal area could be determined (Fig 10).

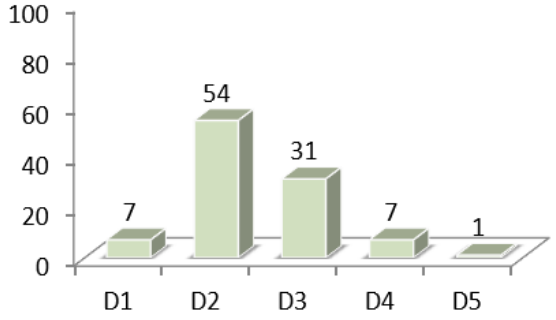

Fig. 10. Bone density at the mandibular level, frontal area

Following the CBCT analysis of the patients of the study group, the bone density at the mandibular level in the lateral area was determined (Fig. 11).

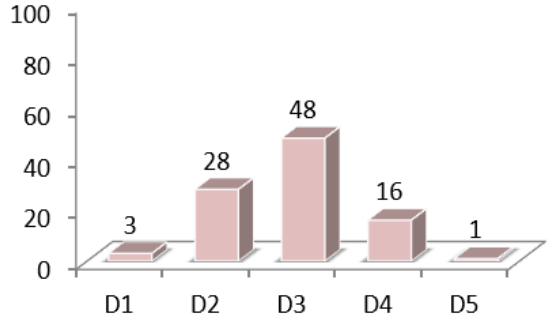

Fig. 11. Bone density at the mandibular level, lateral area

Following the results obtained based on the study of the group of patients, we found that male patients have a higher number of indentations that require implantology rehabilitation (57%), compared to female patients [18-20].

Most of the time, the increased number of edentations present in men is due to vicious habits, accidents, not paying special attention to oral hygiene, and lower concerns about dental appearance [19.18].

However, the awareness of the importance of restoring the entire orofacial system determined the patients of the study group to accept the proposed treatment plan, respectively the implantology rehabilitation provided that they give up vicious habits and dispensary them [20-22].

Also, the frequency and number of edentations increase with age due to various intrinsic and/or extrinsic factors [21.22].

Each patient's treatment plan began with rigorous anamnesis accompanied by clinical and paraclinical examinations. I asked patients with an indication of implantology rehabilitation to perform a CBCT examination by area of interest, with a FOV (field of view) as low as possible, but after which the information is sufficient to be able to perform subsequent clinical simulations and maneuvers [22-23].

In most cases, therapeutic conduct was guided by prosthetic rehabilitation and depending on this, implant treatment.

The correct distribution of masticatory forces through the implantology components was another factor that was the basis of the restorations performed, by trying to optimally position each implant. Although not infrequently we encountered difficulties related to the required aesthetic aspect and desired especially in the frontal area, good results were obtained [20-23].

In the analysis of CBCTs, we followed all the parameters of the hard tissues, and depending on them we opted for the insertion of the implants, ensuring their predictability post-resort through rigorous management of each clinical case [18-20].

Regarding the bone supply, we took into account all aspects necessary for the implant treatment, such as height, width, bone defects, bone density, implant insertion angle, anatomical neighborhood formations, and distance from neighboring teeth [19-23].

Conclusions

Following the personal study of the group of patients, we concluded that the CBCT-type investigation is indispensable for complex and complete implantology oral rehabilitation for each clinical case, taking into account as far as possible, guided insertion of implants from a prosthetic point of view.

To reduce therapeutic failure, the use of CBCT is necessary for several reasons: Clear highlighting of the anatomical structures in the area of interest and their particularities. Indication of the presence, efficiency, and predictability of possible previous treatments. Precise determination of the size of the bone supply in both jaws, as opposed to routine paraclinical investigations, as they may provide erroneous data or do not provide sufficient information.

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Received: October 28, 2022
Accepted: March 12, 2023