Anatomically guided full arch implant-prosthetic rehabilitations

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Abstract

***Aim*: The loss of dental elements causes anatomical, functional, aesthetic, and psychological changes that reduce the patient's quality of life and comfort. This study aims to show how implant-prosthetic restorations with full-arch immediate loading can be appropriately performed by an anatomically guided method.**
***Materials and methods*: Two case reports of two male patients aged 69 and 60 years old who needed an implant-prosthetic full arch rehabilitation were documented to describe the surgical treatment.**
***Discussion*: Human anatomy is the basis of any surgical treatment, so in oral surgery, the operator must have a detailed knowledge of the loco-regional anatomy of the head-neck district. For this reason, it is essential to know the topographical limits of the noble structures typically found in daily clinical practice to perform a precise surgical act under safe conditions. The validity of a complete dental arch rehabilitation method is emphasized in literature by inserting two axial implants positioned orthogonally to the occlusal plane in the anterior region and two distal implants inclined with a maximum of 30° distally in the posterior region. The literature reports of inclined implants have been proposed as an alternative to traditional protocols in rehabilitating edentulous jaws. All this can be achieved by carefully studying the clinical case at the beginning of the clinical and radiographic examination. In addition, knowledge of the anatomical reference points must be taken as a reference to obtain a method that is reproducible and adaptable to more clinical cases depending on bone mineralization.**
***Conclusion*: Although it may seem excessively invasive, this method allows us to obtain optimal and reproducible results. It allows us to exploit not only the biomechanical advantages obtained by the structure of the prosthetic polygon but, above all, those biological ones based on knowledge of the physiology of bone remodeling.**

Keywords: Implant-prosthetic restorations, Anatomically guided method, Full-arch immediate loading.

Introduction

The loss of dental elements causes anatomical, functional, aesthetic, and psychological changes that reduce a patient's quality of life and comfort. Removable total dentures do not guarantee patient comfort, especially in advanced atrophy where the residual alveolar crest is resorbed with poor retention capacity (1, 2).
The resolution of these problems in edentulous patients was achieved by introducing implant-prosthetic restorations with full-arch immediate loading (3). It has been shown that the success of operated implants with immediate loading is similar to that of delayed

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loading implants, thus increasing patient satisfaction as they reduce the operating time between the surgical and prosthetic (4).
Based on Branemark's principles, modern osteo-integrated implantology allows immediate function to be performed, as first published by Malò in 2003 (5-7). Treatment of edentulous atrophic maxillary with immediate full-arch implant-prosthesis rehabilitation involves the placement of four implants at the mandibular level in the area between the mental foramen and in the upper maxilla in the area between the mesial walls of the sinuses (5).
This type of full-arch rehabilitation involves the insertion of two axial implants positioned orthogonally to the occlusal plane in the anterior region and two distal implants inclined with a maximum of 30° distally in the posterior region (8, 9). From the prosthetic point of view, the protocol provides for the implementation of fixed prostheses with immediate load provisional (in 8-48 hours postoperative) and permanent fixed prostheses after 3 months (10).
The realization of a prosthetic polygon, as described above, allows to the realization of fixed full-arch prostheses screwed on a small number of implants. Another advantage is the greater inter-implant distance depending on the inclination used in the insertion of the rear implants, with a design that reduces or eliminates the application of the posterior cantilever completely. This promotes an optimal release of the masticatory forces and thus reduces the functional stresses on the mesial axial implants (11). According to Misch, inserting implants in the intraforaminal zone in full-arch rehabilitation allows for more excellent stability and resistance to stress, bending forces, and deformation during mandibular movements (8).
In implant-prosthetic full arch rehabilitation, it is possible to use distally implants of greater length than axial ones both in the upper maxilla and the mandible (12). Anatomically, anatomical portions of the maxillary bones characterized by high bone density are also used, such as the interforaminal area in the mandible and the mesial bone portion at the antero-lateral wall of the sinus. These characteristics are advantageous surgically since they allow for the obtaining of primary stability and are functional to the immediate load (13, 14). The literature also states that no significant difference in marginal bone loss was found between axial and inclined implants at either upper maxillary or mandibular levels (13).
From the hygienic point of view, the reduced number of implants and the increased inter-implant distance allow a simplification of home oral hygiene maneuvers.
This study aims to show how implant-prosthetic restorations with full-arch immediate loading can be appropriately performed by an anatomically guided method based on a careful study of preoperative examinations and the identification of intraoperative noble structures. The aim is to insert implants into the anatomical sites with optimal bone mineralization.

Materials and methods

Two clinical cases are listed below

Case No. 1
A 69-year-old male patient is reported to the authors. He has a total upper and lower mobile prosthesis, with chewing difficulties.
The anamnesis showed excellent general health without drug therapy.
The patient is evaluated clinically and radiographically. The objective intraoral examination and the X-ray examination (Panoramic X-ray) (Figs. 1-2) showed the need for rehabilitation treatment aimed at functionally and aesthetically rehabilitating the entire masticatory apparatus.

Figure 1. Pre-operatory Panoramic X-ray.

Figure 2. Objective intraoral examination.

Following the analysis of the second-level radiographic examination, such as CBCT, the patient is consulted to satisfy his specific request to perform implant-prosthetic restorations with full-arch immediate loading. The CBCT of the upper arch showed the presence of a large area of osteolytic in the first quadrant at the area of the elements 1.1 and 1.2 extended to the incisor canal (Figure 3).
Specific informed consent was obtained, and the two interventions were carried out separately at intervals of three months.
After having performed the preliminary stages of preparation of the patient for the operation, the was provided triangular anesthesia to the greater palatine and nasopalatine nerves (Mepivacaine 3%) and local anesthesia (Mepivacaine 2% with 1:100,000 epinephrine). After the extraction of the residual dental elements, we followed the execution of the total thickness mucoperiosteum flap with a cold blade in the crestal region slightly paramarginale in the palatal direction, to preserve adherent gingiva, extended from the median region to the area ideally occupied in the arch by the second molar, with incisions of front release in the median and rear vertical zone.

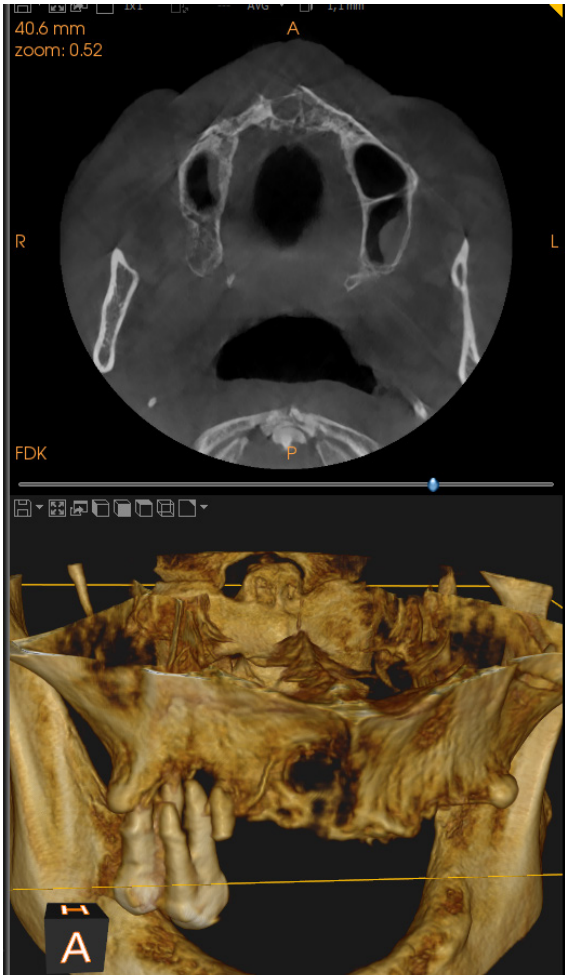

Figure. 3 CBCT.

The flap was then carefully removed at the vestibular and palatal levels to highlight the anterolateral face of the maxillary bone, the canine draft, and the nasal cavities delimited by the piriform aperture and the anterior nasal spine.

Following the surface dishomogeneity, a preliminary stage of preparation of the surgical site is carried out by means of an osteotomy and an osteoplasty to the residual alveolar bone by means of a truncated cone cutter mounted on a straight handpiece 1:1 to provide a plateau respecting the vertical dimension of the patient's starting point.

The careful preliminary study of the CBCT of the upper maxilla and the execution of an accurate and sufficiently extended flap to allow the skeletonization of the surgical site highlight the anatomical references of the anterolateral facial of the maxillary bone corresponding to the sinus, the piriform aperture, and the floor of the nasal cavities.

The implant length is confirmed by measuring the preparation depth with a specific millimeter probe. The next phase involves inserting the implant with a torque of about 35 Ncm.

After the left hemiarch, the same surgical procedures were carried out on the right half-arch.

In each hemiarch, a distal implant of 4 mm diameter and 17 mm length and an axial implant of 4 mm diameter and 10 mm length were inserted. The MUA placed has an inclination of 45° on distal implants and 0° on axial implants.

The procedure ends by suturing the flap with points detached with 3/0 silk thread.

After the hemostasis check, the patient was discharged with a prescription for antibiotic and analgesic therapy and post-operative instructions regarding home hygiene and food standards.

The drug treatment consisted of:

- Amoxicillin and Clavulanic Acid 1 g (CPR), twice daily for 6 days starting from three days before the surgery;
- Pantoprazole 40 mg (CPR), once daily for 6 days from the day before surgery;
- Dexamethasone sodium phosphate 0.2% (oral drops), from the day after the intervention according to the following protocol:
- Naproxen sodium 550 mg (CPR), if needed, 1 tablet every 12 hours for a maximum of 3 days;
- Chlorhexidine digluconate 0.5% gel for plaque control twice daily after oral hygiene at home from 24 hours after the intervention for 15 days.

The prosthesis was delivered after 48 hours, and a post-operatory Panoramic X-ray was performed.

After a week of post-operative follow-up, the patient reported no complications (Figs. 4-9).

Figure 4. Upper jaw for flap incision.

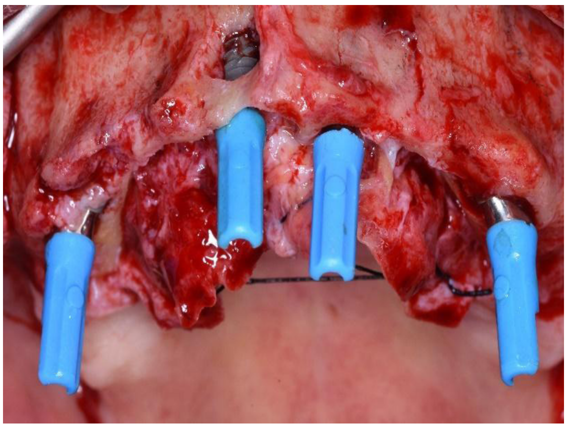

Figure 5. Insertion of implants with positioning of the MUA.

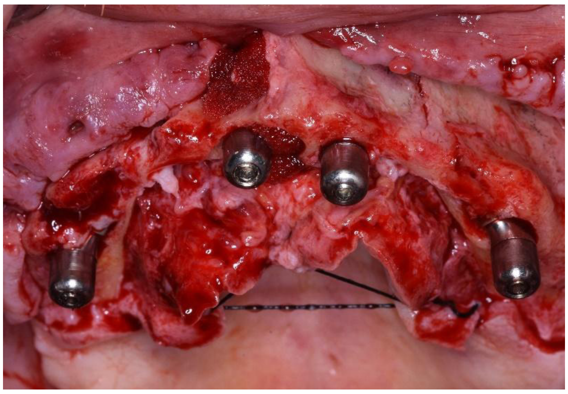

Figure 6. MUA and the healing hoods inserted.

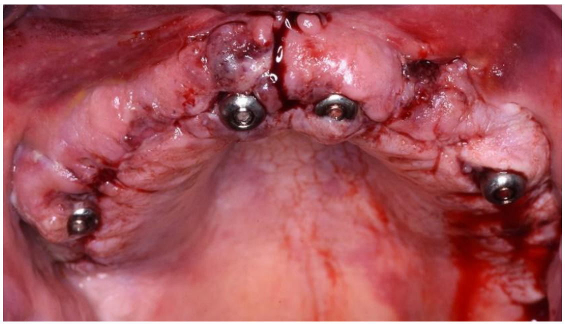

Figure 7. Tissues after suture removal at 48 hours.

Figure 8. Fitting of prostheses.

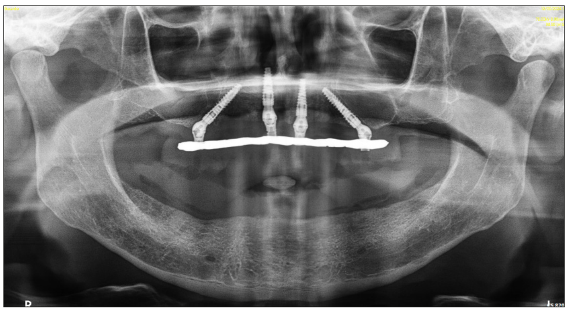

Figure 9. Post-operatory Panoramic X-ray.

Case No. 2
A 60-year-old male patient is reported to the authors to rehabilitate the upper arch using a fixed prosthetic solution.

The anamnesis showed good general health without ongoing drug therapy.
The clinical and radiographic examination showed that the residual dental elements are no longer recoverable (Figs. 10-11). The CBCT is then performed to assess the specific case's bone condition and develop a diagnosis.

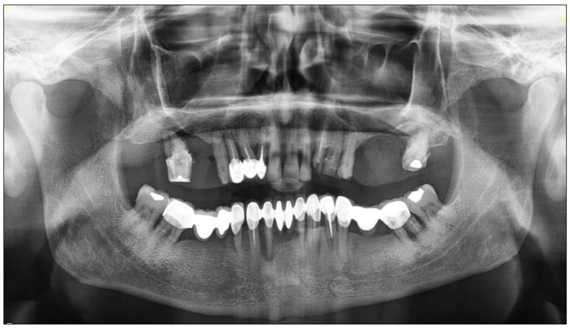

Figure 10. Pre-operatory Panoramic X-ray.

Figure 11. Objective intraoral examination.

After having explained the solutions to the patient, it was decided to a fixed implant-prosthetic rehabilitation with screwed prosthesis immediate load.
After having performed the preliminary stages of preparation of the patient for the operation, the was provided triangular anesthesia to the greater palatine and nasopalatine nerves (Mepivacaine 3%) and local anesthesia (Mepivacaine 2% with 1:100,000 epinephrine).
Following the extraction of the residual dental elements, a total-thickness mucoperiosteum flap was set up at the crystal level in the palatal direction. It was extended from the median region to the area ideally occupied by the second molar, with front release incisions in the middle and rear vertical regions.
To highlight anatomical areas of surgical interest, such as the anterolateral face of the maxillary bone, the canine draft skeletonized by the homonymous muscle and the nasal cavities delimited by the piriform aperture and the anterior nasal spine, the flap is peeled off on the vestibular and palatal slopes.
When the bone surface lacks homogeneity, the surgical site is prepared using an osteotomy and an osteoplasty to level the residual alveolar bone and prepare for a plateau.
As in the previous case, a careful preliminary study of the CBCT of the upper maxilla and the execution of a flap sufficiently extended to allow the skeletonization of the surgical site can highlight the anatomical references of

the anterolateral facial of the sinus, the piriform aperture, and the floor of the nasal cavities.
The choice of the system follows the confirmation of the measurement of the preparation depth by a millimetric probe. The next phase involves implant insertion with a torque of about 35 Ncm.
After the left hemiarch, the same surgical procedures were carried out on the right half-arch.
In each hemiarch, a 4 mm diameter and 17 mm length implant was inserted, and an axial implant of 4 mm diameter and 10 mm length. The distal MUA inclines the first quadrant of 52° and the second quadrant of 60°. The axial MUA has a 0° inclination.
The procedure ends by suturing the flap with points detached with 3/0 silk thread.
After the hemostasis control, the patient was discharged with the same pharmacological and postoperative indications described above (Figs. 12-17).

Figure 12. Upper jaw for flap incision.

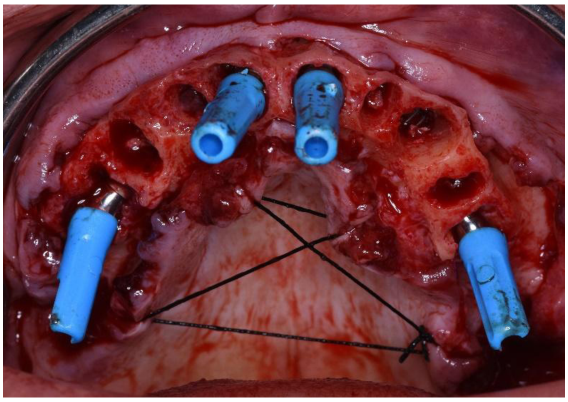

Figure 13. Insertion of implants with positioning of the MUA.

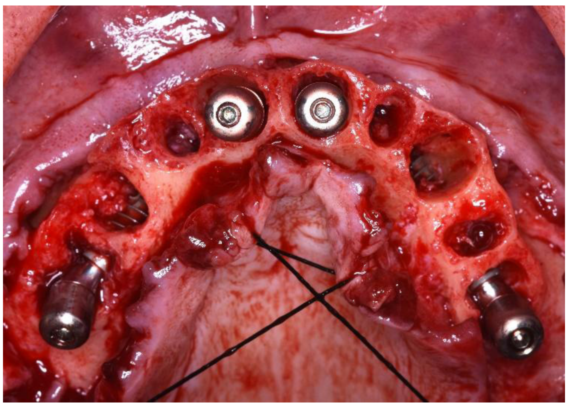

Figure 14. MUA and the healing hoods inserted.

Figure 15. Tissues after suture removal at 48 hours.

Figure 16. Fitting of prostheses.

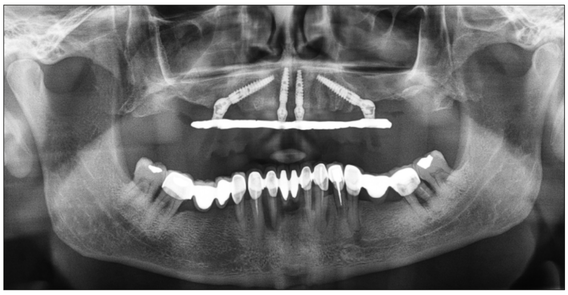

Figure 17. Post-operatory Panoramic X-ray.

Discussion

In medicine, human anatomy is the basis of every surgical act. As such, implant oral surgery cannot escape a detailed knowledge of the loco-regional anatomy of the head-neck district. It is, therefore, essential to be aware of the topographical limits of noble structures typically found in daily clinical practice to perform a precise surgical act under safe conditions.
The maxilla is the central bone pillar in the architecture of the facial skeleton, contributing to the formation of orbital, nasal, and buccal cavities and the infratemporal fossa and pterigo-palatine fossa components (14, 15). Inside the upper maxilla is a pneumatized area, represented by the sinus. The anterolateral wall of the maxillary sinus has a forward-facing quadrilateral shape, which is depressed by the presence of the canine draft and corresponds externally to the lateral wall of the maxillary bone (15). At this level, important anatomical points such as the canine fossa and the infraorbital foramen exist. However, it is not highlighted in the full-arch rehabilitation interventions, containing the homonymous beam and located 5-10 mm below the oral floor. It is also important to point out that this wall is crossed by

a partially intra-osseous vascular anastomosis between the dental branch of the posterosuperior alveolar artery and the infraorbital artery (16). The anterolateral wall of the maxillary sinus is characterized by a reduced bone consistency that allows the definition visually the anatomical limits of the sinusal cavity and to detect possibly, in transparency, a vascular anastomosis that can be visible to better delineate the mesial boundary of the sinus-antrum (14-16). Defining the medial limit of the maxillary sinus, primarily using imaging and then intraoperatively, allows for the placement of the inclined distal implant in safe surgical conditions without creating an antrostomy and reducing the time required by the operators. The inner or nasal wall is rectangular and forms the bone septum separating the sinus from the homolateral nasal cavity with which it communicates using a natural ostium, the maxillary hiatus, located in the anterosuperior portion of the inner wall, in the middle channel (14, 15).
During the entire preparation of the implant site, these anatomical references relating to the maxillary sinus and the distal angle of the piriform aperture are constantly considered. The preparation of the distal implant is then performed by a free-hand surgical technique anatomically guided by the ideal conjunction of the antero-medial wall of the sinus at the residual alveolar ridge in the direction of the target point of the distal angle of the omolateral piriform aperture. It is essential to emphasize that the expansion of the lateral recesses of the maxillary sinus analyzed by appropriate imaging tools and following the intraoperative highlighting of the Conca of the maxillary sinus will decide the angle of preparation in the function of the anatomy of the specific clinical case. For this reason, it is good to highlight the high inclination of the distal implant in both reported clinical cases, especially the use of strongly inclined MUA to be placed on the specific implant. To counteract the typical centripetal reabsorption of the upper maxilla and promote the inserted implant's prognosis, it is preferable to use a palatal approach to prevent intra- and postoperative fenestrations.
In the anterior maxilla, they converge around the alveolar crest: postero-superiorly the nasal cavity and posteriorly the palatine bone. Except for the incisive canals, which emerge at the palatal level in the anterior area of the retro-incisive zone, there are no noteworthy anatomical structures in this area (14, 15). Following these claims, there is the clinical possibility of exploiting this district extensively by inserting implants in cases of severe atrophy. This anatomical portion allows the insertion of two axial implants, similarly described above by a palatal approach, so the implant is positioned safely about the physiological reabsorption centripetal typical of the upper jaw. Usually, as performed in the procedure of patient case 2, it is preferable, following the isolation of the incisive canals, to perform the insertion of the implants in the pre-maxilla without isolating and detaching the floor of the nasal membrane in order to reduce intraoperative bleeding and promote a more favorable postoperative course of the patient. In case 1, due to the presence of the extended osteolytic area, the lesion was removed, and appropriate atraumatic detachments detached the nasal mucosa to allow the preparation and insertion of an axial implant using the phenomenon of bicorticalism at the floor of the nasal cavities.

Conclusion

As highlighted in this study, surgical anatomy is the basis of a thorough implant-prosthesis full-arch rehabilitation as it allows the surgeon to perform an anatomically guided method based on a careful research of preoperative examinations and the identification of intraoperative noble structures by inserting implants in the anatomical sites with optimal bone mineralization.
Although it may seem excessively invasive, this method allows for optimal and reproducible results. It exploits not only the biomechanical advantages obtained by the structure of the prosthetic polygon but, above all, those biological ones based on knowledge of the physiology of bone remodeling.

Declarations

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Conflicts of interest

The authors declare no conflicts of interest

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