



REVIEW ARTICLE

Pre-implant study: interest of the digital prosthetic project

1,*Zineb STRI, 2Leila FAJRI, 3Yassir SABRI, 4Hicham BENYAHIA and 5Nadia MERZOUK

¹Resident Dentist, Department of Prosthetic Dentistry- Consultation Center of Dental Treatment (CCTD) IBN SINA, Faculty of Dentistry, University Mohamed V Souissi, Rabat, Morocco

²Associate Professor, Department of Prosthetic Dentistry - Consultation Center of Dental Treatment (CCTD) IBN SINA, Faculty Of Dentistry University Mohamed V Souissi, Rabat, Morocco

³Doctoral student, Research Team in Biomaterials and Salivary Biomarkers

⁴Associate Professor of Dento-Facial Orthopedics- Consultation Center of Dental Treatment (CCTD) IBN SINA, Faculty Of Dentistry University Mohamed V Souissi, Rabat, Morocco

⁵Professor and Chief Service of Prothodontics Consultation Center of Dental Treatment (CCTD), Faculty Of Dentistry University Mohamed V Souissi, Rabat, Morocco

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The prosthetic project in implantology is a diagnostic process that prefigures the aesthetic, functional and occlusal parameters in a correct static and dynamic context (occlusion plane, vertical occlusion dimension, occlusal curves, lip support...). For simple prosthetic projects (one or two missing teeth), treatment planning is relatively easy. For complex projects, a more detailed analysis is necessary to anticipate and predict on models and/or in the mouth, the position of future prosthetic, by using various "models" or "guides". Fully digital planning can also be used in some situations. The concept of computer-assisted implantology nowadays provides undeniable diagnostic and therapeutic support in response to the increasing demands of partial edentulous patients.

INTRODUCTION

The prosthetic project is a fundamental concept in implantology, it has the heavy responsibility to guide all the stages "from A to Z" of implant therapy. Today, implants are no longer positioned according to the available bone volume but according to the studied, desired and validated position of future prosthetic teeth. This is the "crown-to-bone" approach, since it is surgery that has become a discipline in the service of the prosthesis, and not the other way around. The objective of this article is to show the interest of preimplantation pre-prosthetic study in the exhaustive analysis of the clinical situation, both anatomical and functional and aesthetic in order to establish a treatment plan and achieve its success (1, 2). This study must include: a clinical examination, a radiological examination, a functional analysis with articulator assembly and the aesthetic validation of the prosthetic project.

*Corresponding author: Zineb STRI,

Resident Dentist, Department of Prosthetic Dentistry- Consultation Center of Dental Treatment (CCTD) IBN SINA, Faculty of Dentistry, University Mohamed V Souissi, Rabat, Morocco.

The initial stages of the prosthetic-implant project: In the presence of a patient with edentulous teeth, there are essential parameters to analyze as prerequisites before considering a therapy (implant or not) and outlining a prosthetic project (3, 4). It is also important to take into consideration the patient's personality and the degree of comfort and aesthetic requirements.

Analysis of clinical elements

General condition assessment: The general state of health must be systematically assessed and updated regularly, making it possible to determine the presence of any contraindication interfering with the performance of the surgical and/or prosthetic implant procedure.

Ex-Oral Clinical Examination: It is imperative to analyze certain exotic oral aesthetic criteria during clinical observation, namely: the position of the smile line is important to consider, especially in the case of a gingival smile where the aesthetic requirement requires the use of appropriate surgical means, the examination of the lower level of the face to determine whether

the vertical occlusion dimension (DVO) is appropriate or to be reassessed. It is also necessary to take into account facial and labial elements, including the shape of the lip, the condition of the labial corners, the support of the upper lip and cheeks. Finally, a complete examination of the temporomandibular joints (TMJ) and oral opening should be performed since some surgical techniques (Summers' osteotomy) applied in the posterior areas may find their limits in the event of reduced oral opening (3, 5). All these parameters are important to evaluate in the presence of an existing prosthesis in the mouth because it can serve as a model or even as a starting point during therapy. It can also be a "draft" if there are areas for improvement by informing us about progressive changes to the policy.

Endo oral clinical examination: Only the essential points with regard to the implantoprosthesis project are mentioned: an inspection of the arches and mucous membranes, a digital palpation of the toothless ridges, a periodontal assessment (hygiene, periodontal biotype, chronicity of a periodontal pathology...) an evaluation of residual teeth, an occlusal analysis (Angle class, reference planes, functional examination, para-functions...) and finally an evaluation of the interarcade space.

Functional analysis: analysis of study models on articulator: In order to restore a favourable occlusal context for the integration of the supraimplant prosthesis, the practitioner produces study models, mounted on an articulator, allowing the evaluation of the occlusal curves (flag technique), the prosthetic space (for example, for the placement of a standard single implant between two teeth, the mesio-distal distance required is 7 mm; the diameter of the vestibulo-lingual bone cylinder is 6 mm; height or inter-arch distance is 5mm) and the propulsion/maternality guidance before making diagnostic waxes (wax up) or a steering assembly (Fig. 1; Fig. 2). These wax-up wax models and master assembly make it possible to visualize and prefigure the prosthetic project in accordance with aesthetic and functional criteria (occlusion plane, DVO, occluso-prosthetic concept and diagram, etc.) and thus orientate the prosthetic possibilities. A radiological guide developed from the said project will make it possible to compare the prosthetic requirements with the bone and anatomical context for implant planning: implant size, position, emergence profile, surgical technique to be adopted...

Clinical observation: A 26-year-old patient in good general condition with anterior dentomaxillary disharmony (MDD) and a gingival smile. She went to the consultation at the IBN SINA dental consultation and treatment centre in Rabat for aesthetic rehabilitation and mainly to improve her smile. The exobuccal examination showed DVO and correct labial and jugal support (fig. 3a, b). Endobuccal examination revealed (fig. 4a, b, c): At the maxillary the absence of 14 and 25 with the regression of 15 and 26, a disturbance of the occlusion plane (PO): At the mandible: the absence of 36 and 45. Examination of the study models revealed: a very pronounced Spee curve on the right and left, poorly distributed occlusal contacts and insufficient inter-arch distance at the edentulous ridges (fig5a, b). The radiographic evaluation confirms the MDD and the arcade deviation and shows a higher mandibular bone resorption on the left side (fig. 6a, b). The analysis of the clinical assessment directed towards orthodontic treatment to

correct the various dental disturbances and malpositions and to restore the ideal intra- and inter-arch distances in order to consider unitary fixed implant prosthetic rehabilitations at the level of the recessed edentulas. For this purpose, the prosthetic project was modeled virtually: A digital orthodontic set up was performed with the ORTHOANALYSER 3 Shape software (Fig.7) including the following corrections:

- **At the maxilla:** vestibulo-version and alignment of the 4 mm incisors, adjustment of the axis of symmetry of the arch, rotation of the 16, interference of the 15, distal displacement of the 13 and 23 by 5 mm, interference and rotation of the 26.
- **At the mandible:** adjustment of the median sagittal axis, distal displacement of the 33 and 43 by 3mm. (6, 7, 8, 9)

Subsequently, a preview of the supraimplant fixed restorations was digitally performed using the MESHMIXER software for the placement of crowns (digital wax up) and virtual implants at the 14, 25, 36 and 45 sites that have already been validated and prepared in advance in coupling with the Beam Cone (Fig. 8, 9) (10, 11). Using the beam cone, a 3D simulation of the implant situation was performed using SimPlant® and MASHMIXER software. Once the implant prosthetic project has been established, it will be a tool for communication with the patient and decision-making by informed consent on the respective advantages and disadvantages of the various possible therapeutic techniques: rapid orthodontics by corticotomy, invisalign or conventional treatment... The patient opted for a compromise treatment to close the spaces at sites 14 and 25 in order to avoid the implant option at the maxilla and to place supraimplant unit prostheses instead of mandible prostheses at sites 36 and 45, for both financial and convenience reasons (Figs. 10, 11)

DISCUSSION

The prosthetic project is materialized by various means:

- Wax or digital wax-ups that preview the positioning of future supraimplant prostheses, the correct position of crowns for better integration with the remaining teeth.
- The master assembly of the edentulous area which allows the integration of the prosthetic corridor whether in partial adjoined prosthesis (PAP) or in complete adjoined prosthesis (PAC).
- The orthodontic set up is sometimes necessary to correct the various anomalies of position and dental situation (version, rotation, regression,...)

From the anamnesis and in the light of the established diagnosis, the practitioner is then able to refer the patient to one (or more) prosthetic solution. The prosthetic project can take different forms depending on the type of rehabilitation: fixed (screwed/sealed, screwed, screwed, double-stage screwed connection) or removable: PAP or PAC; the degree of occlusal disturbance and aesthetic considerations. Preprosthetic treatments can be either subtraction (extraction, selective grinding...), addition (coronoplasty...), displacement (orthodontic management...) or surgical procedures (flaps, epithelial-conjunctival graft, bone expansion, guided bone regeneration...).



Fig.1. Static endo buccal view



Fig.2. Materialization of the prosthetic project on articulator: wax up and master assembly

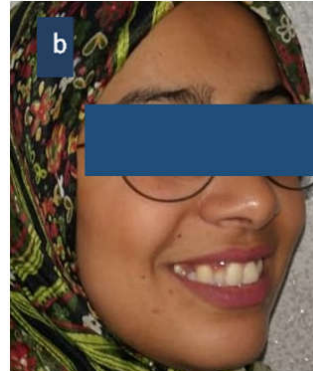
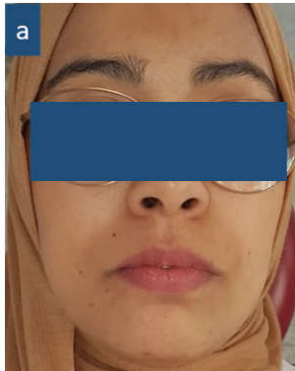


Fig.3a, b. Front view and 3 /4 view showing the patient's smile

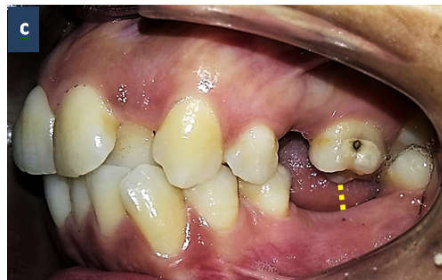
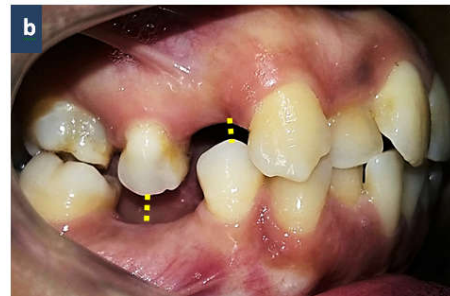
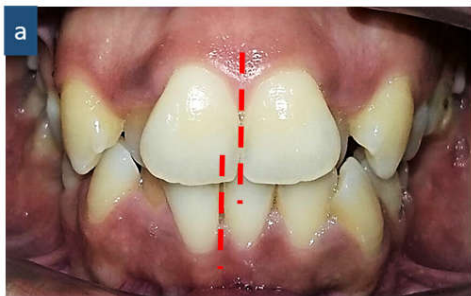
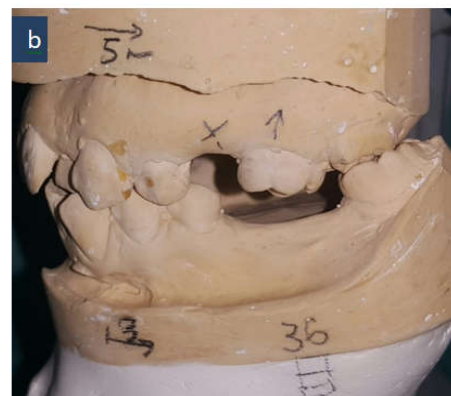
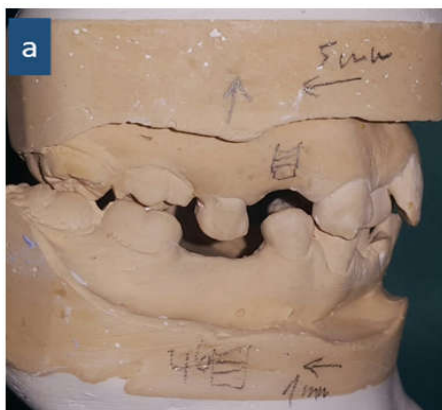


Fig.4a, b, c. Endo buccal view showing the MDD and the different disturbances from the PO to the maxilla to the mandible. a: front view deviation of the median sagittal axis; b: right side: Angle class III; c: left side : Angle class II.



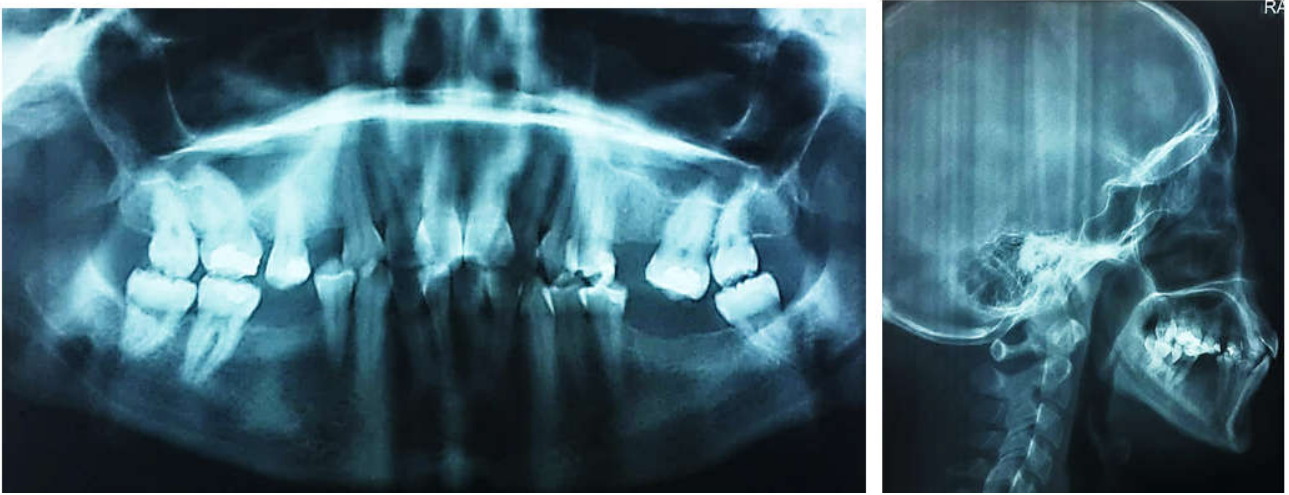


Fig.6a, b. Panoramic radiography and profile telerradiography

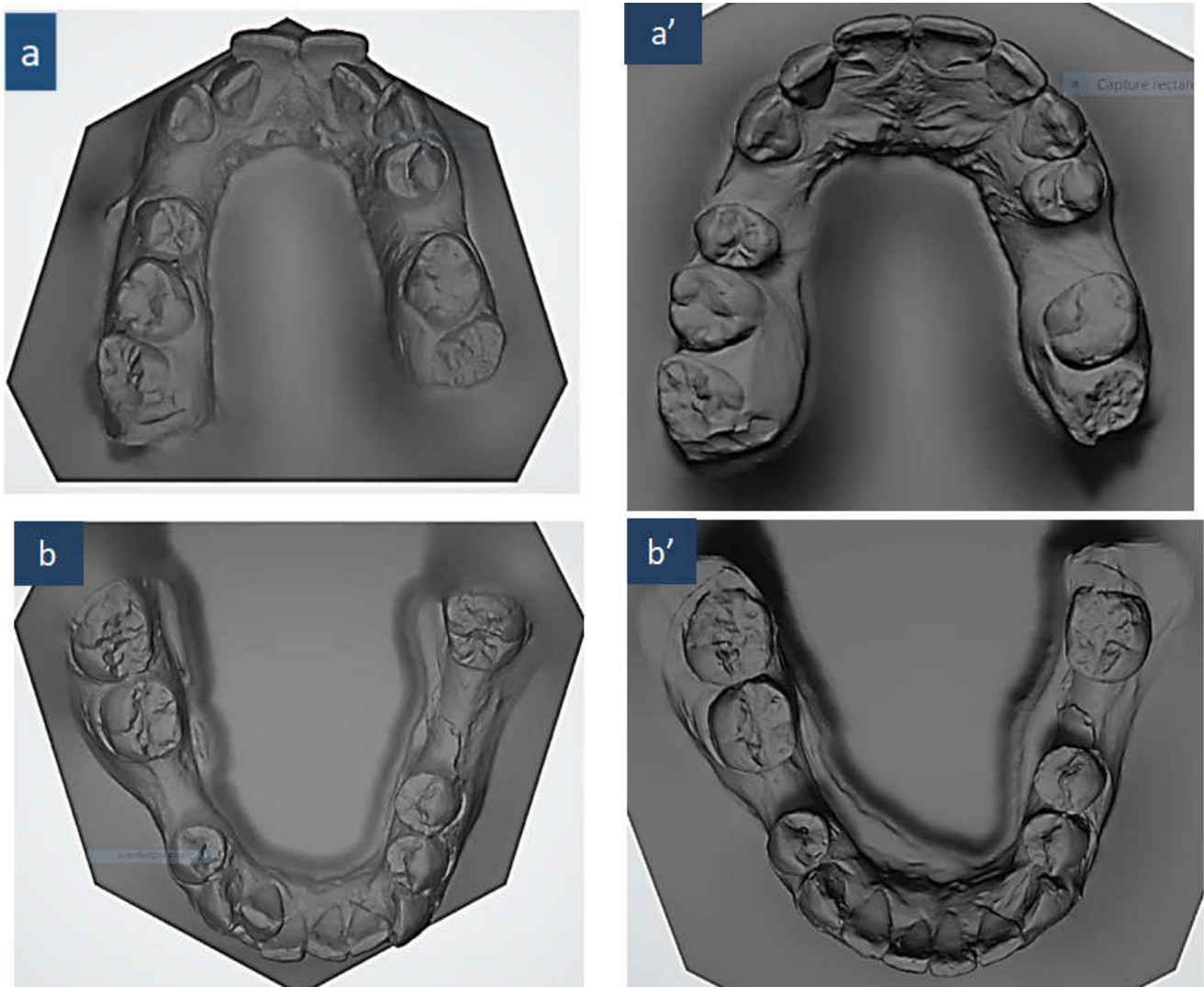


Fig.7 : (a, b). Maxillary and mandibular virtual models after scanning of plaster arches
(a', b') : Virtual models after digital setup

The comparison of the prosthetic project with the radiographic data (beam cone or scanner), using the radiological guide, makes it possible to determine the optimal position of the implants while respecting the prosthetic, aesthetic and functional criteria and to carry out, if necessary, the appropriate peri-implant arrangements to allow the integration of the

supramplant prosthesis (12). Indeed, many studies (13, 14, 15) have shown that the keys to success in implantology are based on precise diagnosis coupled with rigorous implant planning based on a prosthetic project that has emerged as the true guiding principle of all therapy. The concept of computer-assisted implantology now merges all these advanced

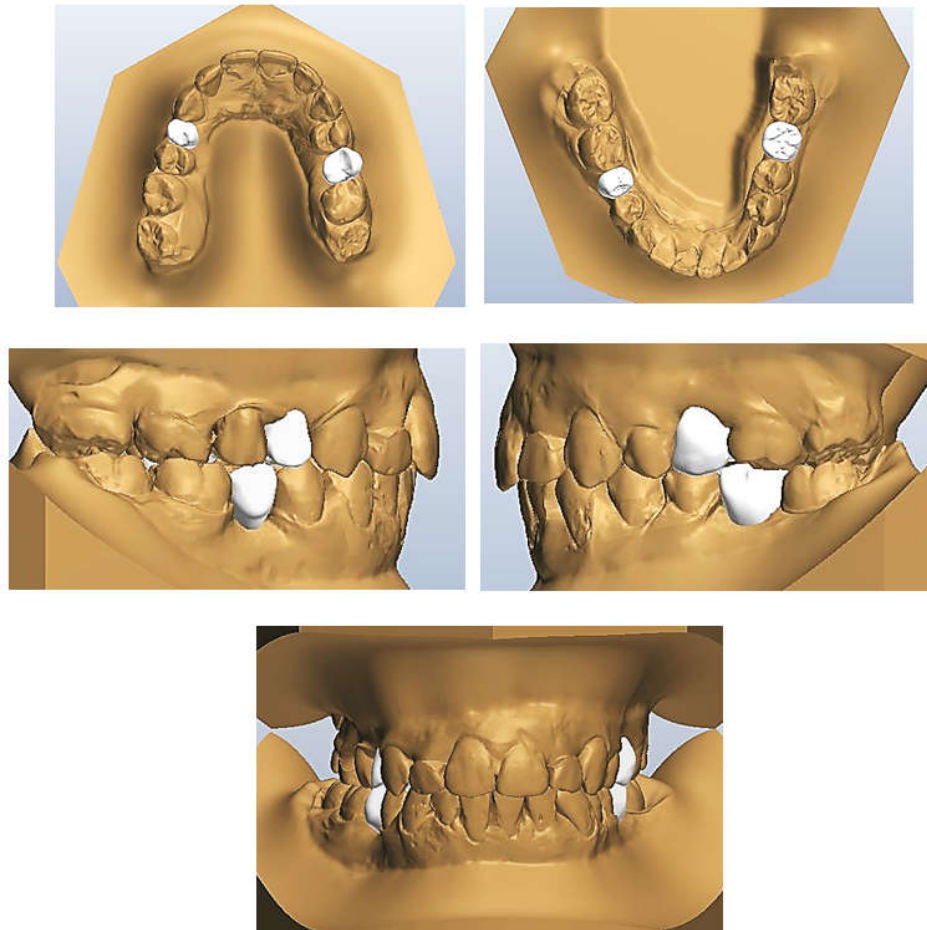


Fig. 8. Location of digital wax-up on virtual models: compliance with occlusal criteria

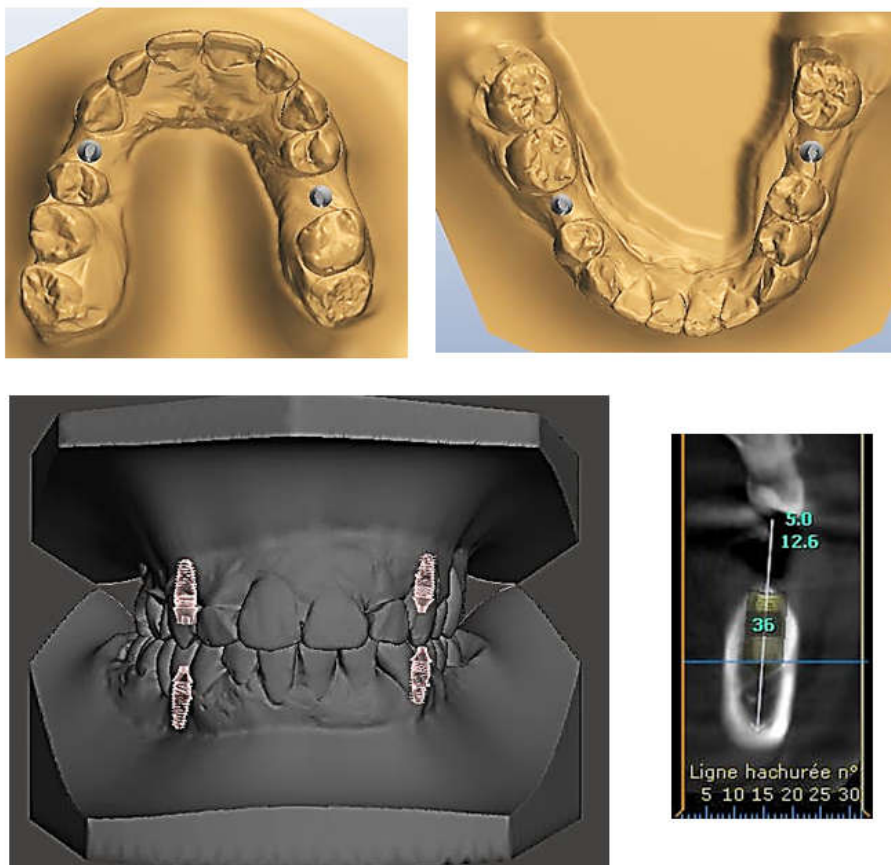


Fig.9. Setting up digital implants according to beam cone data

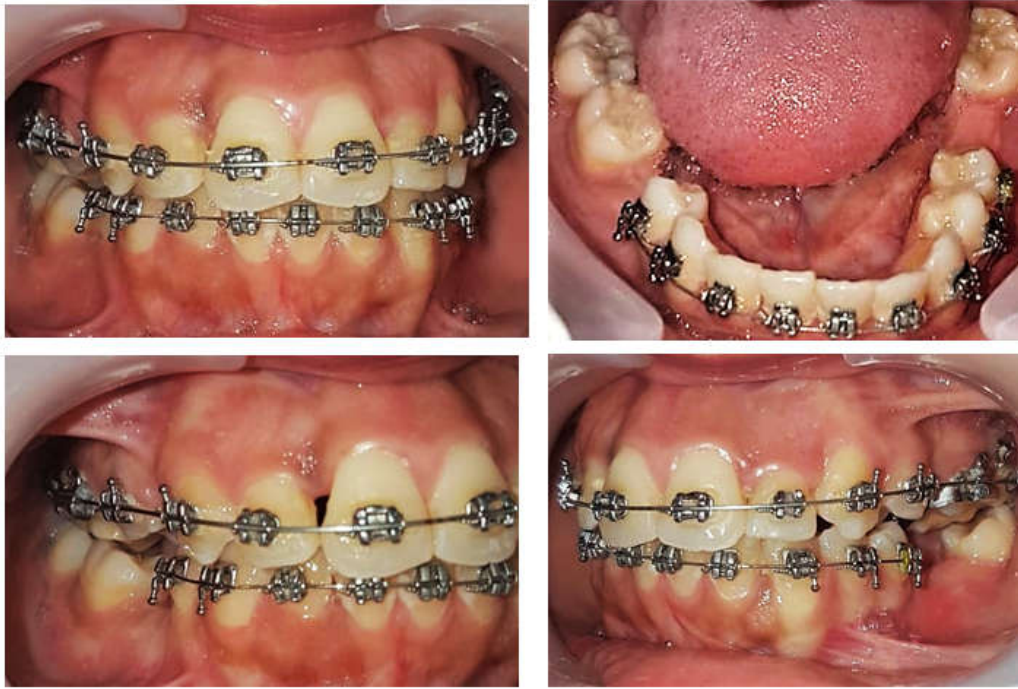


Fig.10. Endo oral view of the current orthodontic treatment performed by Pr. L. OUSEHAL is about: - dental alignment and interincisor points, - closure of the 14 and 25 spaces, - restoration of the occlusion in Angle Class I, - interference of 15 and 24, - conservation of the space required for implants on 36 and 45

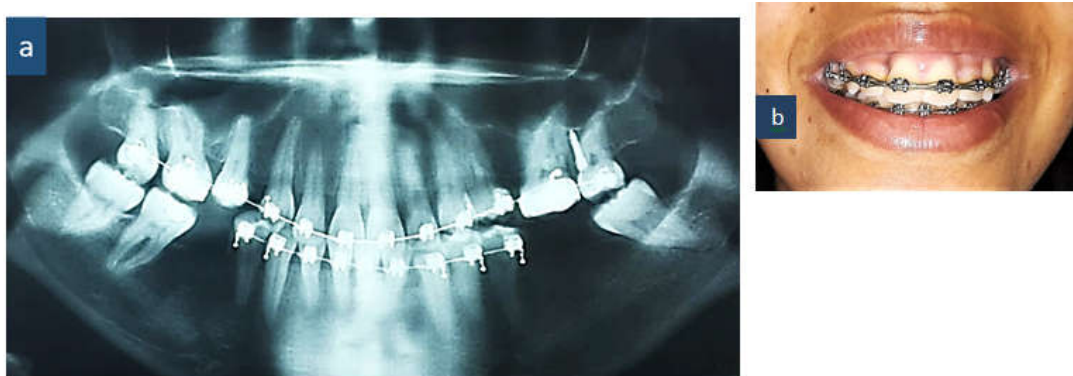


Fig.11a, b. Current state: a: panoramic radiography; b: patient's smile

parameters in order to respond precisely to them. The transfer devices of this virtual planning result in improved three-dimensional implant positioning at the surgical site compared to conventional therapy. The use of more elaborate implant planning allows the practitioner to reduce the risk of iatrogenic damage during surgery and to respond more predictably to patients' increasing aesthetic and functional needs as well as their increasing comfort. At the end of this prosthetic project, sometimes a therapeutic compromise can be adopted depending on the clinical situation, the patient's requirements and the constraints relating to the heaviness of the surgeries, the duration of the treatment and the financial aspect.

Conclusion

The prosthetic implantology project is part of the pre-implant study and is part of an overall rehabilitation. In addition to being a communication tool, it allows the patient's request to be formulated and possible therapeutic responses to be considered, this step brings together the patient, the practitioner and the prosthetist.

A consensus must then emerge where the proposed therapeutic solution meets the patient's expectations. It is essential in the development of the treatment plan. By increasing the number of steps upstream, it reduces errors and difficulties during the actual processing process and thus reduces the processing time of the entire project.

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