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The Conception of Implant Fixed Protheses from Planning to Maintenance

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Introduction

Implant therapy is a reliable therapy of choice for the functional and aesthetic rehabilitation of edentulism [1,2].

In the field of fixed dental prostheses, a conventional implant-supported "bridge" is a fixed prosthesis aimed at replacing missing teeth, consisting of a span embedded at both ends by one or more implants [3]. We distinguish between two types of implant-supported partial fixed reconstructions: implant-supported partial fixed prostheses without extension with or without intermediary (PFPI) and implant-supported partial fixed prostheses with extension (PFPIE) which consist of a span embedded at one end only by one or more several implants while the other end is free, these extensions are generally limited to one tooth [4].

Recommendations have been issued regarding prosthetic rehabilitation treatments using implant-supported partial fixed prosthesis in extensions (PFPIE) [5]. PFPIE treatments are viable treatments, but the patient and the practitioner must be conscious and aware of the risk of complications. The use of an implant supporting two caps is not a recommended procedure in routine practice due to insufficient data, although they are encouraging. It appears that extensions can be used to replace missing teeth, either mesial or distal to implants. The results of this study can only be applied to extensions equal to or less in length than those reported in Storelli's study [6].

The purpose of this article is to concretize the planning of the implant-supported partial fixed prostheses with extension on all its steps.

Conception

Proposal for Specifications

During the EAO consensus conference, recommendations were issued regarding prosthetic rehabilitation treatments by implant-supported partial fixed prosthesis in extensions (PFPIE) [5]. PFPIE treatments are viable treatments, but the patient and the practitioner must be conscious and aware of the risk of complications. The use of an implant supporting two caps is not a recommended procedure in routine practice due to insufficient data, although these are encouraging. It appears that extensions can be used to replace missing teeth, either mesial or distal to implants. The results of this study can only be applied to extensions equal to or less in length than those reported in Storelli's study [5,6].

Implant characteristics

Positioning of implants

- **Vertical direction:** The greater the resorption height, the more apically the implant will be positioned. In his study, Weinberg shows that for every 1 mm increase in positioning in the apical direction, there is approximately a 5% increase in torque [7].

- **Mesio-distal direction:** The stress on the prostheses increases when the space between the 2 implants decreases. Some authors describe a minimum distance of 8 mm between 2 implants from center to center as desirable [8].

Implant diameter

Since the maximum bone stress is located at the level of the implant collar, wide implants are therefore more indicated than long implants to reduce this stress [9]. In addition, studies warn about the use of implants with a reduced diameter less than or equal to 3.3 mm, attesting to a greater number of technical complications such as fracture of the implant [10,11].

Type of connector

In vitro studies have shown better sealing of internal connectors compared to external connectors, but these results remain debatable. Currently, there is no consensus on the most reliable type of connection, but the gap at the abutment/prosthesis interface decreases with the screwing torque of the prosthetic parts together [11].

Prosthetic Characteristics

Crown/implant ratio: The greater the height of the prosthetic space, the greater the crown/root ratio and the greater the lever arm exerted at the level of the implant/prosthesis connector [12]. For every 1 mm increase in crown height from normal anatomical height, strength increases by 20% [13].

Mesio-Distal Extension Length

As the length of the extension increases, the stress distribution in the bone tissue surrounding the implant increases [14].

Dimension of Embrasures

According to the mathematical model of Shillingburg, if we double the bucco-lingual width of the substructure, its resistance doubles and if we double the occluso-gingival height, its resistance is multiplied by 8 [15].

Passivity of the Prosthesis

Failure to fit substructure could create biological and mechanical complications.

Screwed or sealed prosthesis

A systematic study, carried out by Sailer in 2012, compared the survival and complication rates of screw-retained and cement-retained implant-supported prosthetic rehabilitations [16]. The cement-retained reconstructions presented more severe biological complications (loss of implant, bone loss > 2 mm). Screw-retained prostheses presented more technical complications (screw fracture, unscrewing) but these complications were easier to manage. Therefore, although in this study no method of fixation was significantly more advantageous than the other, it seems preferable to use screwed prostheses which have better biological compatibility.

Occlusion

Occlusal overload at the level of an implant-supported prosthesis has a direct impact on the occurrence of technical and biological complications [17]. The occlusion adjustment of these prostheses is of capital importance for the success of this therapy, in particular by the realization of light contacts in occlusion at the level of the extension and the absence of contact in propulsion and laterality at its level. Some authors recommend placing the part of the prosthesis in extension slightly infraoccluded by 100 microns in occlusion [18].

Pre-Prosthetic Phase

Patient Selection

Patient selection is an essential, if not the most important; step in the implant treatment plan. During the first consultation in implantology, the practitioner will listen to the patient to identify his request and will collect medical information that may reveal a contraindication to the realization of an implant therapy.

A contraindication is any condition linked to a risk of infection or any act likely to aggravate the general condition of a patient.

In oral implantology, contraindications exist concerning:

- **Taking bisphosphonates**
  - The risk for patients taking this treatment is to develop osteonecrosis of the jaws.
  - There are no absolute contraindications to implant placement for patients taking oral bisphosphonates.
  - Current guidelines contraindicate the placement of implants for patients taking intravenous (IV) bisphosphonates for malignancy.
  - The placement of implants may be considered for patients on oral bisphosphonates after a rigorous assessment of the benefit/risk ratio.

- **Smoking**
  - Patients who smoke have significantly more peri-implant bone loss than non-smokers [19]. From 10 cigarettes per day, implant placement is contraindicated [20].

- **Diabetes**
  - Implant placement is contraindicated for patients with uncontrolled diabetes [21].

- **Oral hygiene:**
  - The presence of dental plaque is associated with an increased risk of mucositis and peri-implantitis [22].

- **History of periodontal disease**
  - In the literature it is shown that patients susceptible to periodontal disease, with a history of periodontitis, had a potential risk of peri-implant bone loss greater than for healthy patients [23].

- **The volume of keratinized tissue**
  - No association between absence of keratinized tissue and

peri-implantitis has been demonstrated. However, sufficient keratinized tissue height improves esthetics as well as ease of oral hygiene maneuvers [23].

Prosthetic Project

Any implant treatment must be the subject of a case analysis by realizing study models mounted on an articulator to allow the practitioner to reflect on the various therapeutic solutions. A collaboration between the practitioner and the prosthesis laboratory will make it possible to carry out a master assembly simulating an ideal rehabilitation and thus to preview the desired final situation and establish a prosthetic project. It also makes it possible to set up an effective communication tool making it possible to give clear information to the patient and obtain his informed consent.

The transfer in the mouth of the mock-up will allow the validation of the aesthetic project by the practitioner and the patient. Then, from this validated project, we will proceed to the design of the radiological guide, which will allow, during the radiographic examination, the comparaison between the positions of the desired teeth with the position of the patient's bone volume.

Imaging techniques

Complementary radiographic examinations are essential in implantology to analyze the quality and quantity of bone volumes and allow rigorous planning of the case.

- **Retroalveolar radiography**

- This examination will be carried out during the follow-up consultations.

- **Panoramic X-ray**

- It is the examination of “debriefing” which will allow to have a general view of the oral state of the patient. It will be useful during the first consultation but lacks precision to assess the bone volumes available in implantology.

- **Dentascan scanner and reconstruction software**

- Three-dimensional examination that allows very precise identification of the area concerned: visualization of anatomical structures.

- Enables manual planning by overlaying transparent layers on printed sections.

- **Cone beam (cone beam volume tomography)**

- Latest Development of Sector Imaging
- Very precise with a magnification ratio of 1:1
- Enables IT planning
- Less irradiation compared to dentascan.

The shape of the implant corresponding to a "screw" is the one that dominates the market today [24]. The presence of threads provides a large contact surface, increases primary stability, reduces shear stresses at the bone/implant interface, reduces stress concentration in the cervical region and thus improves the osseointegration process. The state of the implant surface: rough surfaces allow contact osteogenesis while smooth surfaces lead to distant osteogenesis. Rough surfaces offer better results than smooth surfaces in terms of osseointegration [25].

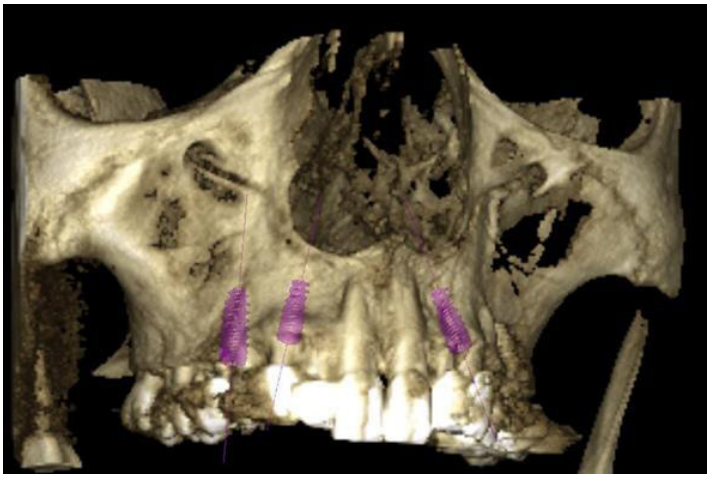

Figure 1: 3D reconstruction of Mrs. LEC.AN's maxillary arch and planning of the placement of future implants.

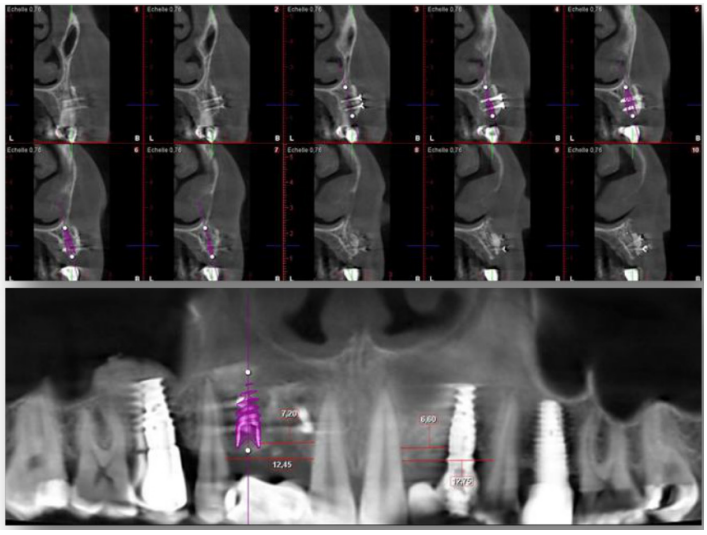

Figure 2: Implant planning of Mrs. LEC.AN for the placement of an implant in 13: above: transverse sections spaced 1 millimeter with positioning of the implant; bottom, panoramic.

Prosthetic Phase

Impression techniques

To make the impression for positioning the implants, a suitable commercial impression tray will be chosen which will be perforated next to the implanted site. Direct implant impression transfers (for prostheses on a single implant) or MUA (Multi Unit Abutment) transfers, screwed into the prosthetic abutments (for prostheses on several implants), depending on the case, will be used. The material used will be of the polyether type, chosen for its resistance to deformation. The transfers, in the case of several

adjacent implants, are not joined together. Once the impression has been made, the implant replicas will be screwed manually with a screwdriver by creating a counter-torque.

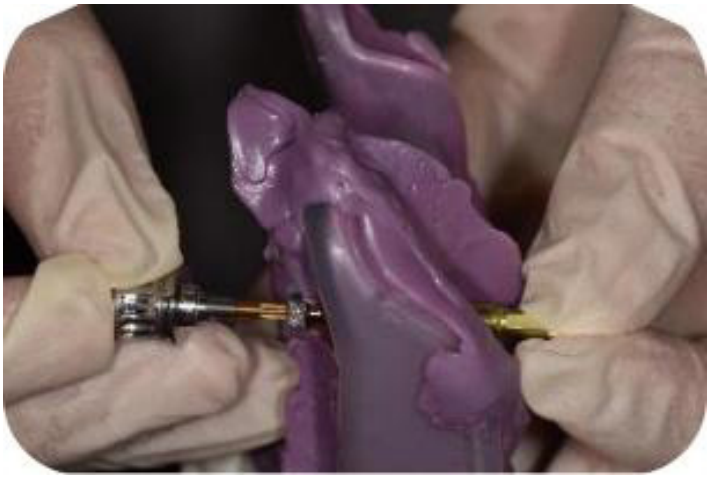

Figure 3: Counter-torque technique when screwing an implant replica into an impression coping.

Fingerprint Validation

Once cast, a validation key will be produced in "Snow white" plaster, with a section of 1 cm² and areas of weakness, on the working models. This key will be transferred in the mouth and the absence of cracks and fractures in the plaster will be checked visually and radiographically. This step will validate the working models.

Bite Registration

The registration of the occlusion will be carried out by screwing on a bite model in wax and preferably with a hard base in resin. The maxillary model will be set up in the articulator by performing a transfer with a face bow and the mandibular model will in turn be set up on a semi-adaptable articulator. On the liaison form with the laboratory, the shape of the desired framework will be drawn and the prosthetic design materials will be indicated.

Fittings try-in

This is an essential step for the success of the treatment over the long term. Machined reinforcements have a greater manufacturing precision than cast reinforcements due to the deformation caused by the retraction of the metal during the cooling phase.

We proceed to the validation of the framework both on the plaster model, then in the mouth successively by realizing to check the passivity of the framework, that is to say the ideal adaptation and the absence of hiatus to the frame/pillar junction. The visual method is more sensitive than using a probe, with an accuracy of 50 microns (Christensen JPD 1966). An orthogonal retroalveolar (RA) X-ray with angulator will be performed. Finally, we can also use the method described by Jemt, which consists in carrying out a clamping resistance test. A first prosthetic screw is screwed manually. Then, we put the second prosthetic screw in place, we start to screw and when we feel a tactile resistance, we take it as a mark on the screwdriver and the latter should not realise more than a quarter of a turn before the screew reaches its abutment.

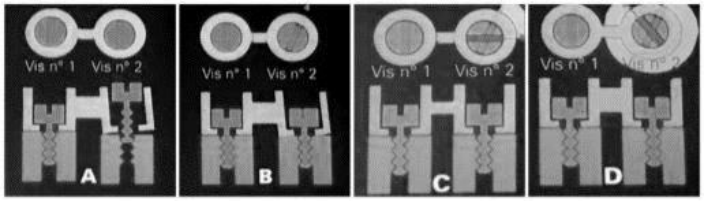

Figure 4: Diagram reproducing the passivity tests of Jemt.

Once the prosthesis is in the mouth, we will check whether the spacing in occlusion between the armature and the opposing arch is sufficient to allow a minimum ceramic thickness of approximately 1.5 mm occlusally as well as at the level of the point of contact.

If the assembly in the articulator does not correspond perfectly to the clinical reality, in the mouth, a new recording will be made with an occlusion wedge made of "duralay" resin or wax. Finally, the prosthetic shade will be taken by positioning the patient facing natural light, specifying to the laboratory the type of shade guide used.

Trying out the jacket crown

After disinfection of the prosthetic parts, we will first check on the models set in the articulator the contacts in occlusion, in static and dynamic, with thin occlusion paper, before comparing with the occlusion in the mouth. The prosthetic screws will be hand-tightened and the strength of the contact point will be assessed by passing interdentally between the mesial extension and the last tooth. The point of contact must be "light" because when tightening with the key, this contact will be reinforced.

Try-in and putting in the mouth of the prosthesis

After checking the occlusion and validating the aesthetics, the prosthesis screws must be tightened with a torque wrench to a torque of 15 N/cm² (Manufacturer's reference)

The prosthetic screws are first tightened gradually, and then they are all retightened.

Using a torque wrench at a torque of 15 N/cm². We temporarily seal the access well with Teflon and gutta and an appointment is scheduled in the following 7 to 15 days with the patient.

During the follow-up appointment, the screw holes are sealed with heated gutta percha and composite, which is the best solution for an optimum sealing (84).

Maintenance

The frequency of peri-implant and prosthetic maintenance [26] depends on the patient's risk factors, including risk factors for peri-implantitis. During these sessions, we will carry out the updating

of the medical file, a complete clinical examination with evaluation of plaque control thanks to the plaque score [27]. An examination of the health of the peri-implant tissues using bleeding indices and gingival appearance: absence of bleeding on probing, appearance and color of the tissues, absence of exudate [27–29], measurement of the width of the keratinized mucosa surrounding the implants. The absence or presence of mobility of the implant will be realized.

An examination of the implant-supported prosthesis as well as a radiographic control of the placement of the prosthetic pillars, during the installation of the implant-supported prosthesis, 6 months after loading, 12 months after then once a year will be carried out. Finally, we will proceed to the elimination of plaque and tartar deposits and the enhancement of oral hygiene techniques.

Conclusion

The extensions can be used when making fixed prostheses and do not negatively interfere with the survival or success of the prostheses or marginal bone loss around the implants. In the literature there are no recommendations concerning the realization of PFPI. What emerges from these studies is the correlation between the length of the extension and the increase in the distribution of forces around the implants supporting the prosthesis. All agree on the fact that the success of the use of an extension in partial fixed prosthesis implant supported is multifactorial and depends on both the clinical situation and the experience of the practitioner. The success of an implant-supported fixed prosthesis will be influenced by various factors such as the presence of an extension in occlusion, the prosthetic biomaterial, the number, position and characteristics of the implants supporting it, the type of antagonist, the masticatory force and the length of the extension. It is important to note that the occurrence of technical complications does not necessarily compromise the longevity of prosthetic rehabilitations with extensions, but that these require rigorous fabrication, precise occlusal adjustment and regular monitoring of the patient [11]. Finally, the realisation of this type of prosthesis would be contraindicated in patients suffering from bruxism.

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