„GR.T.POPA” UNIVERSITY OF MEDICINE AND
PHARMACY OF IAŞI

FACULTY
OF DENTAL MEDICINE

REZUME

DOCTORAL THESIS

Implant and Denture Rehabilitation;
Priority of Modern Therapeutic
Solutions for Partially Extended and
Fully Edentulous Patients

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Iasi 2014
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Keywords: PARTIALLY EXTENDED, FULLY EDENTULOUS, IMPLANTS, LOCAL AND SYSTEMIC FACTORS, ELECTRO-CORROSION TESTS, CLINICAL-THERAPEUTIC MANAGEMENT
INTRODUCTION

For many partially extended and fully edentulous patients, dental implants represent the only possibility to anchor some combined / joined gnatho-denture apparatuses. The dental denture restorations on implants have demonstrated their superior, functional and psychological qualities, of which their bearers can beneficiate: developing the sense of liberty, possibility to eat what they desire, speaking without phonation defects, smiling without any restriction, a state of personal health improved a lot, physical attraction, confidence and safety, emotional awarding. Also, with the help of dental implants, elder patients with advanced atrophy of the alveolar ridges, patients with advanced parodontopathies and those with osteoporosis have found the resolution of their dental problems.
STATE OF KNOWLEDGE

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ANATOMICAL CONSIDERATIONS REGARDING THE ORAL REHABILITATION ON IMPLANTS

Chapter 2
EVALUATION PARAMETERS OF THE BONE OFFER IN PARTIALLY EXTENDED AND FULLY EDENTULOUS PATIENTS

Chapter 3
TYPES OF IMPLANTS USED IN SUBTOTAL OR TOTAL EDENTULESNESSE THERAPY
PERSONAL PART

Chapter 4

4.1. RESEARCH METHODOLOGY, CREATING A DATABASE

4.1.1 RATIONALE:

Total edentulousness can be restored with dentures by many types of dentures with implant support: fixed partial denture, patient (or doctor) partially mobilized denture, mobile denture (supra denture maintained and stabilized by buttons or on pole such as meso-structures). Most of the patients ask for fixed denture restorations and only after multiple discussions and explanations, they accept other solutions, too.

Many fully edentulous patients request for implant insertion on both jaws, but the majority has difficulties in adapting to full dentures on the jaw,

Subsequent to concerns in current practice and during the doctoral preparation, I have proposed myself:

- Gathering a documentary material that integrates the data in the specialty literature, regarding the different forms of partially extended, partial and full edentulousness, as well as the different modalities of implant treatment.
- Studying the clinical, paraclinical and systemic aspects of the studied partially extended and fully edentulous patients, with or without dentures, in the complex program of distinguishing, assessing and treating the patients.
- Performing statistical, clinical and experimental studies on a personal data basis regarding the state of local and systemic health in edentulous patients who asked for
implant – denture treatment at the personal office or in the UMF Gnatho-denture Clinic of Iasi.

4.1.2. OBJECTIVES

In order to achieve these goals, the following objectives were appointed:

- Elaborating a complete assessing program that contains:
  - The diagnosis related to the evolitional state,
  - The general and particular objectives of each clinical case,
  - The study of case load that forms the data basis for statistical processing,
  - Establishing the basic pathogenic factors,
  - Defining the clinical elements, the paraclinical investigations, the functional explorations and tests for a certain and differential diagnosis.
  - Organizing a monitoring program of the studied patients

The database regarding the selection, examination and evolution of the cases was created in a period of 5 years.

4.1.3. RESEARCH DIRECTIONS

The performed study was oriented in the following directions:

- The clinical study regarding the identification of some clinical cases that need modern denture solutions.
- Image assessment of the edentulous patient in order to identify the clinical cases that need modern denture solutions
- Impact of the local and systemic factors in the implant decision
- Chemical analysis of the implant surfaces after electro-corrosion tests
Clinical and therapeutic management of the partially extended and full edentulousness with implants

In order to assess the results of the implant-denture rehabilitation, as priority of the modern treatment solutions of the partially extended and fully edentulous patients, we pluri-dimensionally approached the studied human sample by clinical, paraclinical, statistical and experimental investigations.

4.2. CLINICAL STUDY REGARDING THE IDENTIFICATION OF SOME CLINICAL CASES THAT NEED MODERN DENTURE SOLUTIONS

4.2.1. Scope
The scope is to identify the partially extended and full edentulousness cases that need modern denture solutions, based on a strict evaluation of the general – systemic and local status.

4.2.2. Material and method
The studied group consisted of 234 patients, representing the database processed during the entire research, male and female, with age between 45-75 years, with partially extensive and fully edentulousness, which requested gnatho-denture treatment. In order to identify the cases that can benefit of modern solutions for implant-denture treatment, we analyzed the general status (cardio-vascular, respiratory, gastro-intestinal, nervous, endocrine, renal and dermatological) that allows the evaluation of the patient’s general status, specifying if the patient can accept such an intervention or presents a risk.
We took into consideration the absolute and relative contraindications of the implant therapy.
Table 4. I. Absolute systemic contraindications of the surgery treatment for implant insertion:

<table>
<thead>
<tr>
<th>State of health</th>
<th>Risk upon the general state of health</th>
<th>Seriousness of the immediate complications</th>
<th>Long term prognosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recent myocardial infarction</td>
<td>++++</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Valvular denture</td>
<td>++++</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Serious disorders of the renal function</td>
<td>++++</td>
<td>++++</td>
<td>0</td>
</tr>
<tr>
<td>Severe diabetes</td>
<td>+++</td>
<td>++++</td>
<td>0</td>
</tr>
<tr>
<td>Generalized secondary osteoporosis</td>
<td>++</td>
<td>++++</td>
<td>+</td>
</tr>
<tr>
<td>Blood alcohol content on age groups chronic / severe alcoholism</td>
<td>++</td>
<td>++++</td>
<td>0</td>
</tr>
<tr>
<td>Advanced Osteomalacia</td>
<td>+</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td>Radiotherapy</td>
<td>+++</td>
<td>++++</td>
<td>0</td>
</tr>
<tr>
<td>Important hormonal disorders</td>
<td>+++</td>
<td>++++</td>
<td>+</td>
</tr>
<tr>
<td>Drug addiction</td>
<td>++</td>
<td>++</td>
<td></td>
</tr>
<tr>
<td>Severe chronic nicotine addiction</td>
<td>++</td>
<td>++</td>
<td>+</td>
</tr>
</tbody>
</table>

Table 4. II. Relative systemic contraindications of the surgical treatment for implant insertion

<table>
<thead>
<tr>
<th>State of health</th>
<th>Risk upon general state of health</th>
<th>Long term prognosis in absence of a diagnosis correct treatment</th>
<th>Long term prognosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIDS</td>
<td>++++</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Prolonged cortical therapy</td>
<td>+++</td>
<td>++</td>
<td>+++</td>
</tr>
<tr>
<td>P-Ca metabolism disorders</td>
<td>+++</td>
<td>++</td>
<td>+++</td>
</tr>
<tr>
<td>Hematopoietic diseases</td>
<td>+++</td>
<td>+</td>
<td>+++</td>
</tr>
<tr>
<td>Mouth and pharynx tumors</td>
<td>+++</td>
<td>++</td>
<td>+++</td>
</tr>
<tr>
<td>Chemotherapy</td>
<td>+++</td>
<td>0</td>
<td>+++</td>
</tr>
<tr>
<td>Light disorders of the renal function</td>
<td>+</td>
<td>0</td>
<td>+++</td>
</tr>
<tr>
<td>Liver and pancreas diseases</td>
<td>+++</td>
<td>0</td>
<td>+++</td>
</tr>
<tr>
<td>Endocrinologic disorders</td>
<td>+++</td>
<td>0</td>
<td>+++</td>
</tr>
</tbody>
</table>
Mental illnesses | + | 0 | +++
Unhealthy lifestyle | ++ | + | +++
Nicotine addiction | ++ | + | +++
Lack of motivation | 0 | + | ++
Incorrect treatment plan | 0 | 0 | ++

The number of + represents the seriousness of the complications associated to treatment by implant: less serious (+), the most serious (+++), 0 = doubtful prognosis.

4.2.3 Results and discussions

**Characteristics of the study group**

The studied group consisted of 234 patients, 120 males and 114 females, with ages between 45-75 years, from urban and rural area, with partially extensive and fully edentulousness, who requested gnathodenture treatment.

![Figure 4.1 Repartition by sexes of the study group](image_url)
Repartition by age groups is presented in Table 4.III. and Figure 4.2

Table 3.III. Repartition by age groups of the study group

<table>
<thead>
<tr>
<th>Interval</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>45-54</td>
<td>27</td>
<td>23</td>
</tr>
<tr>
<td>55-64</td>
<td>38</td>
<td>36</td>
</tr>
<tr>
<td>65-74</td>
<td>35</td>
<td>33</td>
</tr>
<tr>
<td>75-</td>
<td>20</td>
<td>22</td>
</tr>
</tbody>
</table>

Figure 4.2. Repartition by age of the study group
Of the assessed patients, a number of 12 male and 10 female had absolute systemic contraindications of the surgical treatment by inserting implants (table 4.V).

**Table 4. IV. Repartition of patients with absolute systemic contradictions of the surgical treatment for implant insertion**

<table>
<thead>
<tr>
<th>State of health</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recent myocardial infarction</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Valvular dentures</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Serious disorders of the renal function</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Severe diabetes</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Generalized secondary osteoporosis</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Chronic / severe alcoholism</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Radio therapy</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Important hormonal disorders</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Drug addiction</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Severe chronic nicotine addiction</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

The general contraindications that aim the implant insertion in full edentulousness do not differ from the general contraindications of the field. A special mention is the one for smokers, who in certain countries beneficiate of this therapy by legislation. Of course, there are absolute contraindications: patients with serious hypertension, decompensated cardiopathies, insulin dependent diabetics, patients with
neoplasm that are irradiated or under chemotherapy cures, etc, but also in relative and temporary contraindications (Table 4.V and fig 4.4).

**Table 4.V. Relative systemic contraindications of the surgical treatment for implant insertion**

<table>
<thead>
<tr>
<th>State of health</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prolonged cortical therapy</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>P-Ca metabolism disorders</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mouth and pharynx tumors</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Chemotherapy</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Slight disorders of the renal function</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Liver and pancreas diseases</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Endocrine disorders</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Mental illnesses</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>
Figure 4.3. Graphical representation of the patients with relative systemic contraindications of the surgical treatment for implant insertion

Regarding the relative systematic contraindications of the surgical treatment for implant insertion, of the assessed patients, a number of 9 males and 12 females had contraindications in relative systemic contraindications.
Depending on the sex criterion, in the male lot, 10% had absolute contraindications, 8% relative while 82% fulfilled the systemic conditions to get a surgical treatment for implant insertion.

Similar data were met in the female group, with 9% absolute systemic contraindications, 11% relative contraindications and 82%
without systemic contraindications of the surgical treatment for implant insertion.

- in order to identify the cases that can beneficiate of modern solutions of implant-denture treatment, the entire group was examined for general state of health, (cardio-vascular, respiratory, gastro-intestinal, nervous, endocrine, renal and dermatological investigations), which can contraindicate the implant-denture treatment.
- of the assessed patients, a number of 12 males and 10 females had absolute systemic contraindications of the surgical treatment for implant insertion.
- regarding the relative systemic contraindications of the surgical treatment for implant insertion, of the assessed patients, a number of 9 males and 12 females had relative systemic contraindications.
- depending on the sex criterion, in the male lot, 10% had absolute contraindications, 8% relative while 82% met the systemic conditions for performing the surgical treatment for implant insertion.

Similar data were met in the female group, with 9% absolute systemic contraindications, 11% relative contraindications and 82% without systemic contraindications of the surgical treatment for implant insertion.

- hence the requirement for the specialist that the implant indication is established: based on thorough investigations of the general state of health of the edentulous patient (a special attention must be given to the mental state) and also based on a thorough analyze of the morfo-structural individual characteristics, about the edentulousness form and for choosing between classical dentures and implants, and about the state of tissues that will sustain the implant.
Chapter 5

IMAGING ASSESSMENT OF THE EDENTULOUS PATIENT IN ORDER TO IDENTIFY THE CLINICAL CASES THAT NEED MODERN DENTURE SOLUTIONS

5.1. Scope

*Bone X-ray Assessment* as indispensable element of the diagnosis and implant indication, allowing for bone assessment for the implant.

5.2. Material and method

In order to assess the patients, we used the following types of imaging investigation

- OPT
- Computerized tomography

The X-ray exam was performed in all patients selected for implant-denture therapy.

5.3. Results and discussions

With the help of the tomography, panoramic images, axial sections, transversal sections and tridimensional images were obtained.
Figure 5.2 Jaw axial image with transversal sections
The use of conventional X-rays must be included in the traditional clinical planning by recording the most simple X-ray parameters.

X-rays can help identify the teeth with a poor prognosis and localize the plaque retentive structures, the dental caries and the peri-apical pathology that were not detected by clinical assessment. X-rays contain the usual method of assessing the image of the ridge alveolar bone or of the special areas of interest.
Placing a dental implant imposes a thorough X-ray analysis of the alveolar support. After the implant optimal site was found, the doctor must analyze the capacity of the bone support of receiving the implant from the point of view of length, diameter and angulations. Using CT together with the 3D simulation software became more and more used. The new CT generations are capable of offering excellent quality information at isotropic pixel level. Although the results were impressive, the CT should be used only in complex cases where cost/benefit ratio is acceptable.

5.4. Conclusions

- The clinical parameters can be used in establishing a diagnosis for creating a treatment plan, in order to assess the disease risk, to document the high tissue stability, to remodel or affect and to detect the risk factors.
- The conventional X-rays represent reliable procedures with small dose that, anyhow, are not fully adapted yet in dental practice.
- The digital image is not superior than the film based X-rays in the detailed image of the periodontal structures.
- The methodology error magnitude of each X-ray method limits the quantity of the real change in the disease status that can be detected with a certain level of confidence.
- Present image processing is a pure research tool to identifying the subtle changes in tissue density.
- X-ray parameters can be used to establish the diagnosis, to create a treatment plan, to estimate the risk to the disease, to document the tissue stability, remodel or involve and probably to detect the periodontal risk factors for cardio-vascular phenomena.
- It is necessary to develop a diagnosis system that is combined and overlapped with the X-ray image
- The strict standardization of projection geometry with serial X-rays combined with image processing can lead
to a much more sensitive detection and a quantification of light tissue changes.

- Image processing can reduce inter- and intra-observer variability.
- Subtraction digital X-ray and computer assisted densitometric analysis are indispensable tools for research but probably it will not win applications in daily practice until that equipment can be found at a reasonable price.

Chapter 6

IMPACT OF LOCAL AND SYSTEMIC FACTORS IN IMPLANT DECISION

6.1. Scope

This study’s scope is to identify the systemic factors and other intra-oral factors connected to early failure incidence. The main goal is to suggest that these factors can lead to an early implant failure.

6.2. Material and method

The group of patients consisted of 83 patients, (55 females; 28 males) with average age of 56.2 years, who received a total of 185 endoosseos implants during the study period. The study lasted for 5 years.

The patients were recruited for a clinical and X-ray evaluation. They were treated for the periodontal disease before installing the implants and incorporating the supra-structures. All utilized implants were Nobel Biocare and Alpha Bio Dental Implant System and were inserted according to the Producer’s instructions. The supra-structures were made of singular crowns and partial fixed dentures that were applied at 4-6 months after intervention.
Immediately after the initial periodontal therapy, the patients received a supporting periodontal therapy, at periods between 3 and 6 months. At each examination, during the 5 year investigation, all biological complications (peri-implantitis) were registered and treated according to the maintenance / care protocol. (Lang, 2000)

6.2.1 Clinical examination

The same clinical and X-ray evaluation was performed after one year and after 5 years of examinations, including the following clinical parameters:

- Depth at probing
- Attachment level – for assessing the bone loss
- Bleeding at probing.

All measurements were applied in four zones of each implant, using the periodontal probe. The distances were measured up to the closest millimeter.

6.2.2 X-ray examination

X-rays were obtained from 1 to 5 years of functioning. The changes in bone height were also recorded during the observation period.

This study success criterion was made according to Karoussis and col (2003), including:

1. Absence of mobility
2. Absence of prolonged discomfort (pain, foreign body feelings or dysaesthesia),
3. Absence of pouches > 5mm,
4. Absence of pouches =5mm and bleeding at probing +,
5. Absence of continuous radio-transparency around the implant,
6. After the first year of the implant, the annual vertical bone loss must not exceed 0.2 mm. the implant is considered a failure (implant with complications), if the medial or distal annual bone loss exceeds 0.2 mm or if the probing depth exceeds 5 mm, or is equal to 5 mm and the probing bleeding is positive.
An implant can be considered successful if it fulfilled both clinical and X-ray criteria.

We should mention that the assessment of the success rate did not include only the implant surviving, but also those inserted at the beginning of the observation and qualified as being “failure”. Obviously, the exclusion of the failed implants would increase the success level, but it would also lead to misinterpretations of the real situation.

Early failures were connected to:

- The presence of health or behavioral factors,
- Prescribing pre-antibiotics or immediately after the intervention,
- Apical lesion detected at X-ray,
- Medical history of periodontal disease that was incorrectly treated or that is recurrent

Patient’s general state and medical history were recorded with the help of a questionnaire. Furthermore, the medical status was assessed by using hospital records, if any, if the family physician was not asked.

The following aspects were particularly evaluated:

- smoking,
- hypertension,
- heart problems,
- gastric conditions,
- osteoporosis,
- hypercholesterolemia,
- type I or II diabetes,
- rheumatoid arthritis,
- hysterectomy
- drug administration (antidepressant, steroids, hormonal substitutes).
In case of the therapy with hormonal substitutes, the failure rate was compared between patients of female sex over 50 years and with hormonal substitutes.

The edentulousness type was classified depending on the presence and location of the natural teeth in the oral cavity in connection with the implant location: total edentulousness, teeth present in the antagonist jaw only, teeth present in the same jaw as the implant but not neighboring with it, and teeth neighboring the implant.

The implant was considered a failure if:

- the radio-transparency of the peri-implant could be detected in the intra-oral X-rays,
- the intra-oral implants showed the least sign of mobility according to Periotest values (Siemens, A. G, Bensheim, Germany)
- the patient showed subjective signs at pain or infection that needed implant removal.

Using antibiotics pre or immediately after surgery was defined as yes or no.

6.3. Results

Survival rate

Table 6.I – Survival and failure rate in implants after 5 years, in patients with or without periodontal disease history

<table>
<thead>
<tr>
<th>Group</th>
<th>Survival rate (%)</th>
<th>Failure (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A – patients with periodontal disease history</td>
<td>90,5</td>
<td>9,5</td>
</tr>
<tr>
<td>B - patients without periodontal disease history</td>
<td>96,5</td>
<td>3,5</td>
</tr>
</tbody>
</table>
Incidence of biological complications

Table 6.II - Incidence of biological complications for a 5 year period of the implants put in patients with or without periodontal disease

<table>
<thead>
<tr>
<th>Group</th>
<th>No. implants without complications</th>
<th>Incidence of complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>A - patients with periodontal disease history</td>
<td>71,4</td>
<td>28,6</td>
</tr>
<tr>
<td>B - patients without periodontal disease history</td>
<td>94,2</td>
<td>5,8</td>
</tr>
</tbody>
</table>

Success rate

The success rate in implants applied to the two groups of patients is presented in Table 6.III.

Table 6.III Implant Success rate

<table>
<thead>
<tr>
<th>Group</th>
<th>No. of implants</th>
<th>success rate</th>
<th>clinical success</th>
</tr>
</thead>
<tbody>
<tr>
<td>A patients with periodontal disease history</td>
<td>21</td>
<td>11 (52.4%)n</td>
<td>15 (71.4%)</td>
</tr>
<tr>
<td>B patients without periodontal disease history</td>
<td>91</td>
<td>72 (79.1%)</td>
<td>86 (94.5%)</td>
</tr>
</tbody>
</table>
Table 6.IV. Prescription of antibiotics before or immediately after implant insertion

<table>
<thead>
<tr>
<th>Prescription of antibiotics</th>
<th>No</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Success</td>
<td>98.21%</td>
<td>98.15%</td>
</tr>
<tr>
<td>Failure</td>
<td>1.79%</td>
<td>1.85%</td>
</tr>
</tbody>
</table>

Table 6.V. Edentulousness type

<table>
<thead>
<tr>
<th></th>
<th>Edentulous antagonist arch</th>
<th>Neighboring teeth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Success</td>
<td>99.54%</td>
<td>95.85%</td>
</tr>
<tr>
<td>Failure</td>
<td>0.46%</td>
<td>4.15%</td>
</tr>
</tbody>
</table>

Table 6.VII. Influence of smoking upon implant failure

<table>
<thead>
<tr>
<th></th>
<th>Non-smoker</th>
<th>Smoker</th>
</tr>
</thead>
<tbody>
<tr>
<td>Success</td>
<td>98.88%</td>
<td>94.44%</td>
</tr>
<tr>
<td>Failure</td>
<td>1.12%</td>
<td>5.56%</td>
</tr>
</tbody>
</table>
Table 7. Failure rate in female > 50 years, with or without hormonal therapy

<table>
<thead>
<tr>
<th></th>
<th>Female &lt; 50 years with SH</th>
<th>Female &lt; 50 years without SH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Success</td>
<td>90.48%</td>
<td>98.37%</td>
</tr>
<tr>
<td>Failure</td>
<td>9.52%</td>
<td>1.63%</td>
</tr>
</tbody>
</table>

6.4 Discussions

Taking into consideration these cases, the endoosseos implants must be applied only if the body allows it.

The density of the bone tissue depends on the balance between the formation and the bone reabsorbtion in close connection with bone remodeling that is determined by the number of bone remodeling units that act in a certain period of time. Any change in the formation or reabsorbtion process can trigger an imbalance in the bone tissue and in the bone tissue density. Age and sex represent the main problems of the implanting therapy because these parameters cannot be modified. If these factors interfere with alcohol consumption, smoking and drugs, the bone density can be seriously affected.

Early failures result in the inability to establish a bone-implant intimate contact. This means that bone healing after implant insertion is damaged or jeopardized. The mechanism that normally leads to healing by bone application does not take place and the scarred fibrous tissue is formed between the implant surface and the surrounding bone. The failures were associated both with peri-implantitis and occlusive overheating.

6.5. Conclusions

- The 5 year study showed that oral implants can be inserted and
maintained both in patients with or without a history of periodontal disease.

- Patients with a medical history of periodontitis showed a lower level of the implant survival (90.5% vs. 96.5%), a higher increase of the complications (28.6% vs. 5.8%) and a small success rate (71.4% vs. 94.5%) compared to the other patients with edentulousness caused by other motives than periodontitis.

- The survival rate for the implants replacing the dental losses due to periodontal causes was of 90.5%, while the survival rate of the implants for replacing the teeth lost from different causes (caries, fractures, traumatisms) was 96.5%. As it can be easily noticed, the failure rate in group A was 9.5% and in group B was 3.5%. This difference is not very important statistically, as the difference between the survival norms is obvious, especially after 6 years since using the implants.

- 71.4% of the implants belonging to the patients of group A lacked biological complications (peri-implantitis), while 94.2% of the implants belonging to group B did not have any biological complication during the 5 year assessment.

- The 5 year cumulative incidence of peri-implantitis was 28.6% for the patients of group A and 5.8% for the patients of group B.

- Smoking also had a significant influence in early failures of the implants, according to the two statistical methods used.

- Certain factors like hypertension, ischemic diseases, osteoporosis, hypo and hyperthyroidism, type II diabetes, rheumatoid arthritis, hypercholesterolemia, antidepressants and steroid mediations, did not lead to an elevated incidence in early failures.

- On the other side, gastric disorders, Type I diabetes and radical hysterectomy increase the incidence of early failures. Thus, in the presence of this kind of conditions, the therapeutic variant should be performed taken into consideration a more classical denture approach.
Chapter 7

CHEMICAL ANALYSIS OF IMPLANT SURFACES AFTER ELECTRO-CORROSION TESTS

7.1. Introduction

Hydroxyapatite deposits on titanium-based dental implants increase the biocompatibility properties of these components due to the particular features of the ceramic HA material. It is important to establish whether this gain in biocompatibility by HA deposits on surfaces does not impede on the corrosion resistance properties of Ti-based implantable materials.

7.2. Scope

Since natural saliva varied as far as its chemical composition, pH or mineral features are concerned, its interaction with various metal contained in the implant varies greatly from one person to another. Therefore, we analyzed the behavior in artificial Afnor saliva and in Ringer solution of a titanium-based alloy used in dental implants improved by superficial HA coating.

7.3. Material and Method

We conducted corrosion and electro-corrosion tests on HA-coated Ti6Al4V alloy (by the PLD method), in different electrolyte media (artificial Afnor saliva solution and Ringer solution).

Samples of titanium-based implantable material enhanced by superficial HA coating transformed by laser ablation method were subjected in similar conditions to corrosion and electro-corrosion tests in various electrolyte solutions.

The electrolyte solutions employed were artificial Afnor saliva and Ringer solution, electrolyte media covering a wide range of natural salivas and biological Ringer solutions.
The analysis of the electro-corrosion behavior of artificial Afnor saliva was conducted on an area of $0.2061 \, \text{cm}^2$ and at a solution pH of 7.08, and the readings were provided by the AMMONIA and pH meter OP 264/1 devices; as for the ringer solution, we analyzed an area of $0.2256 \, \text{cm}^2$ and the solution pH at the time of the test was 6.12.

After having performed the tests, accompanied by electrolyte solution aeration, the surface of the material was analyzed by microscopy and chemical analysis.

The chemical analyses were performed on an EDAX (Bruker) device connected to a scanning electron microscope. For the chemical analyses we employed the Automatic and Elementlist modes. Depending on the readings, we conducted both qualitative and quantitative analyses. For the micro area analyses we used the Point, Linescan and Mopping reading modes included in the Esprit analysis software.

7.4. Results and Discussions

1 Chemical qualitative analysis in artificial Afnor saliva, after electro-corrosion tests on the HA-coated Ti6Al4V alloy (by the PLD method)

The chemical qualitative analysis of the surface of the material enabled us to identify a high number of chemical elements involved in material surface compound formation, of the coating obtained by hydroxyapatite ablation and of the metal substrate. Thus, we identified the following chemical elements: Cl, K, Fe, Ca, P, Ti, Al, which are included in the energy spectrum in figure 1.

The K, Cl, Fe, Ti and Ca elements are involved in the formation of compounds with two energy values depending on the compound they are involved in.
Figure 7.1. Spectrum of the energies of the elements involved in the formation of compounds from and on the surface of the material subjected to electro-chemical corrosion

The quantitative chemical composition at the surface of the material is shown in table 7.1 with values both for the mass percentages and for the atomic percentages of the chemical elements achieved. We determined a Ca:P percent ratio of 1.83, which is a value appropriate for modified HA obtained by laser pulsing, which proves superficial material corrosion even when the material was subjected to electro-corrosion and not only to standard corrosion. The occurrence of electro-corrosion in the salivary environment or in the complex solutions existing in the human body may also be accounted for in the absence of any direct contact of two metals, by the formation of galvanic microcells, by the mere presence of 3-4 close implants in the same upper or lower area of the oral cavity and the connection of these elements by an electrolyte solution and the occurrence of galvanism.

Figure 7.2 shows the distribution of the main elements on the surface in b) on a specific area selected in a). The superficial hydroapatyte coating has low distribution signal and reveals the formation of fluorine- and iron-based compounds and also the occurrence of corroded areas revealed by the strong oxidized aluminum signal.
The compounds occurring on the surface of the material are easy to remove and have no stable bonds with the metal substrate. Figure 3 shows the distribution of the Ti, Na, F, Fe, Al, Cl, Ca, K and P elements on an implant area between two coils of the bone mass anchoring thread.

The anchoring thread move impairs the signal surface analysis and is revealed only on its upper side, where the HA coat is also detected.
The behavior of the Ti6Al4V implantable material enhanced by superficial HA coating transformed by laser ablation is generally very good in artificial Afnor saliva solution, as the surface of the material shows no signs of flaws after electro-corrosion or stable compounds.

2. Chemical qualitative analysis in Ringer solution, after electro-corrosion tests on the HA-coated Ti6Al4V alloy (by the PLD method)

As far as the chemical composition is concerned (fig. 4), the following chemical elements were identified on the surface of the material: Ti, Ca, Si, Cl, Na and O. A very small amount of P element was detected on the surface of the material as the superficial hydroxyapatite coating was oxidized and phosphorus occurred in smaller amounts due to the corrosion of the micronic particles of transformed HA coating.
Figure 7.4. Spectrum of the energies of the elements involved in the formation of compounds from and on the surface of the material subjected to electro-chemical corrosion

The analysis of the distribution of the main elements occurring on the surface in b) on a specific area selected in a) is described in figure 7.5., which also reveals certain compounds on the surface of the chloride- and sodium-based material. The areas where these compounds occurred further to the electro-corrosion process considerably diminish the titanium signal, which shows that they are thicker than 50 µm.
We proceeded by analyzing the nature of one of the compounds which occurred on the surface, from the electrolyte solution, and which was selected in figure 6.a), by determining its chemical composition. The chemical analysis is performed on an area of 90 nm$^2$ and the qualitatively identified elements are shown in the spectrum in figure 7.6.b).

**Figure 7.5. Analysis of the distribution of the main elements on the surface in b) on a specific area selected in a)**
Figure 7.6. Microscopy of the surface of the material with the selection of a chemical analysis spot in a) and the spectrum of the chemical elements energies identified in the selected spot in b)

The quantitative chemical analysis of the compound occurring on the surface, shown in table 7.III, reveals that it is an oxide, carbonate and potassium and sodium salt compound. The analysis also identifies small amounts of titanium, calcium and phosphorous in the substrate.

The parameters of the electro-corrosion process are extensively described in literature.
In our study, the parameters of the electro-corrosion process supported the very good behaviors of the tested materials when exposed to corrosion in the two artificial media.

Dental implants are considered basic therapeutic solutions. The published data showed high success rates of implants placed on extensively or totally edentulous arches.

In addition to allowing accurate diagnosis setting and treatment plan implementation, determining the properties, long-term behavior, indications and contraindications of each material used are essential for assuring the long-term clinical success of restorations.

7.5. Conclusions

- The results show very good sample behavior in the testing solutions both to corrosion and electro-corrosion.
- As far as the microstructure is concerned, we detected no micro-fissures, “pitting” effects, pores or exfoliations of the coat deposited by material electro-corrosion in any of the electrolyte solutions.
- We noted the corrosion of the micronic hydroxyapatite formations and a slight material damage at the nanometric level. The surfaces are highly oxidized.
- On small areas, smaller than 5%, we noted various formations, chlorine-, sodium- or potassium-based compounds, which were easily removed by distilled water flushing.
- When we analyzed the behavior in a Ringer solution we noted the formation on the surface of several complex oxide-, carbonate- and salt-based compounds that could not be removed by washing.
- The Ca:P ratio in the HA modified by laser ablation was more or less the same in the areas not affected by the compounds that migrated from the electrolyte solution to the surface.
- The material obtained by HA coating on titanium-based implant substrate behaved well from the standpoint of the rate of
corrosion in the tested solutions, and the readings were somewhat similar.

Chapter 8

CLINICAL-THERAPEUTIC MANAGEMENT OF PARTIAL EXTENSIVE and TOTAL EDENTULOUSNESS BY IMPLANTS

8.1. Scope

The purpose of the study is to detect complex oral rehabilitation methods used in the management of partial extensive, subtotal and total edentulousness, and to customize the therapeutic algorithm in full agreement with the variety of clinical cases, which is a basic requirement influenced by a series of factors such as general status, clinical and paraclinical characteristics of the prosthetic field and last but not least the social and economic implications.

8.2. Material and Method

The study was conducted on a group of 86 patients diagnosed with partial extensive and total edentulousness, aged between 40 and 60, in whom the general status parameter was extremely important for the development of a treatment plan.

The assessment of the therapeutic complex oral rehabilitation algorithm applied to partially, subtotally and totally edentulous patients was done by considering the comparative aspects between the various therapeutic alternatives, by explaining and correlating the positive and negative morphofunctional aspects, which are a faithful representation of the rehabilitation algorithm.

These patients benefited from the full therapeutic algorithm, which consisted of the rehabilitation of their partial extended and total edentulousness by implants.

The indication of prosthetic restoration of total edentulousness by implants was dependent on:
1. the available bone mass of the hard structures of the prosthetic field;

2. the topographic area where the implants may be inserted;

3. the general and local health state, which needs to be good;

4. sufficient inter-arch vertical space – prior DVO calculation;

5. good oral cavity hygiene;

6. non-smoker and not a heavy drinker.

Implant contraindications in totally edentulous patients were related to:

- the general status (cardiac, nutrition, blood, endocrine or renal conditions, malignant illnesses, heavy smokers, alcoholics, etc.) may be an implant contraindication;

- the local status, where the relative or absolute contraindications are related to the occurrence of premalignant and malignant lesions, of oral mucosa mycosis, poor oral hygiene (proven by the state of the removable dentures).

8.3. Results and Discussions

Depending on the morpho-functional characteristics of the clinical cases and for social-economic reasons, the treatment solutions chosen for partial extensive endentulousness patients included:

26 patients – removable/mobile dentures by classical means

1. partial acrylic dentures with wire brackets, as therapeutic solutions for financially challenged individuals - 11 cases
2. connector dentures with cast brackets; - 3 cases

3. connector dentures with special maintenance, support and stabilization connecting/disconnecting components; - 5 cases

4. over-lays –1 case

5. total removable dentures -6 cases

66 patients were provided with implants and dentures

Fixed denture restoration on implants -42 cases

Overdenture on implants -24 cases
Figure 8.50. Finished gnatho-prosthetic devices

Figure 8.51. Finished treatment

Removable denture on implants
Partial fixed dentures (bridges) supported only by implants are prosthetic restorations, which are sometimes hard to perform in totally edentulous patients. They are completely different from partial aggregate dentures supported by natural abutments.

Several problems may occur when treating an edentulous jaw by fixed prosthetic restorations on implants, which may be prevented when placing overdentures on implants. The most common of these are:

1. divergent implant axes and vestibular tilting;
2. elongated teeth effect;
3. wide inter-teeth spaces;

Figure 8.57. Prosthetic therapeutic variant: in the mandible – removable denture on implants with special bar components

Figure 8.58. Prosthetic therapeutic variant: total maxillary denture and removable denture on implants with special bar components
4. incongruity between the position of the implant and the position of the artificial teeth.

Achieving an adequate outline of the soft tissues around the implants throughout the whole edentulous field may be a difficult task in fixed prosthetic restorations supported by implants. There is a risk of dark cervical abrasions and elongated teeth effect especially in the failing ridges. Therefore, for esthetical reasons, the best solution would be an overdenture, the vestibular slope of which prevents the problems described above and provides adequate support to the soft parts.

8.5. Conclusions

• There are numerous therapeutic solutions for edentulous patients, therefore the right choice should be done judiciously, considering the specificity of each patient and in full agreement with the requirements of each case, and subject to the technological limitations that the dentist is faced with.

• The negative clinical-biological indices occurring in the prosthetic field limit considerably the therapeutic solutions available, the best of which is actually a compromise between the optimal approaches, which allows failing system rehabilitation.

• A full and accurate assessment of the prosthetic field is absolutely essential when making therapeutic choices, yet one must not be oblivious to the social and economic implications of each case which, beyond the admirable prosthetic restoration solutions available, are decisive when choosing a therapeutic approach.

• Outpatient follow-up is extremely important since, although the prosthetic solutions adopted admirably restore the harmony of the entire maxilla-facial area affected by edentulousness, changes may occur, which are due to natural processes related to age or associated diseases, as well as to improper hygiene.
• The management of the patient qualifying for implant-denture is very complex, considering the identification of these cases, the specificity of the clinical-paraclinical assessment performed before implant placement and the patient’s general state, as well as the particular implantation aspects and long-term success.

• There are numerous therapeutic solutions for edentulous patients, therefore the right choice should be done judicially, considering the specificity of each patient and in full agreement with the requirements of each case.

• A full and accurate assessment of the prosthetic field is absolutely essential when making therapeutic choices, yet one must not be oblivious to the social and economic implications of each case which, beyond the admirable prosthetic restoration solutions available, are decisive when choosing a therapeutic approach.

• Outpatient follow-up is extremely important since, although the prosthetic solutions adopted admirably restore the harmony of the entire maxilla-facial area affected by edentulousness, changes may occur, which are due to natural processes related to age or associated diseases, as well as to improper hygiene.

• Overdentures on implants prove efficient and have several advantages as compared to fixed prosthetic restorations supported by implants.

• The bar and riders system has been proven to increase stability to vertical and horizontal dislocating forces.

• Due to the improvement of the stability of the anterior part of the denture, the posterior section of the denture withstood a load 30% higher.

• The treatment of complications of overdenture is more time and money consuming than the treatment of complications of fixed dentures supported by implants (these findings are different
from the one published by Davis and Watson, Walton and McEntee).

- Hygiene is more efficient in overdentures with bar and riders system.

- The tissues around the implants do not respond to dental plaque as periodontal tissues do. No correlations were found between soft peri-implant tissue changes and osseointegration. Several years after implant insertion, no correlations were found between implant failure and the dental plaque, gum bleeding or other periodontal impairment index.

- The quality of the peri-implant bone in the two therapeutic approaches seems similar.

- A patient whose bone reserve is good enough to support implants designed for fixed dentures may be the perfect candidate for overdenture supported by implants. In these cases, the therapeutic decision is made depending on the patient’s preferences, hygiene quality, esthetical and psychological implications or financial resources.

- Less invasive, cheaper, less complex and yet efficient solutions should be preferred.

Chapter 9

GENERAL PRACTICALLY APPLIED CONCLUSIONS

- The study group included 234 patients who made up the database processed during the whole research, male and female, aged between 45 and 75, with partial extensive and total edentulousness, who wanted gnatho-prosthetic and implant-denture treatment.

- In order to identify the cases that qualify for modern implant-denture treatment solutions, we started by assessing the general health
state of the whole group (cardio-vascular, respiratory, gastro-intestinal, nervous, endocrine, renal and dermatological exams), in order to detect the implant-denture treatment contraindications.

- Among the examined patients, 12 males and 10 females had absolute systemic contraindications for surgical implant insertion.

- As concerns relative systemic contraindications for surgical implant insertion, 9 males and 12 females of the examined patients had them.

- As far as the sex criterion is concerned, 10% of males had absolute contraindications, 8% of them had relative contraindications, whereas 82% of them met the systemic requirements for surgical implant insertion.

Similar data were collected in the female group, 9% of whom had absolute systemic contraindications, 11% had relative contraindications and 82% had no systemic contraindications for surgical implant insertion.

- This means that when deciding to perform implant insertion the specialist should rely on: a detailed examination of the edentulous patient’s health state (special attention should be paid to the patient’s mental status) and on a thorough analysis of the individual morpho-structural characteristics, as concerns the edentulousness form, in order to choose between classical denture and implant, also considering the state of the tissues that will support the implant.

- The clinical parameters may be used in diagnosis setting for the development of a treatment plan, for determining the disease risk, for documenting high tissue stability, remodeling or impairment and for risk factor detection.

- Conventional X-rays are trustworthy low dose procedures, which are not fully adapted to dental practice.

- Digital images are not better than film-based X-rays, which provide a clear and detailed image of the periodontal structures.
- X-ray parameters may be used for diagnosis setting, for the
development of a treatment plan, for determining the disease risk, for
documenting high tissue stability, remodeling or impairment and
probably for periodontal cardio-vascular risk factor detection.
- A diagnosis setting system should be developed, which could
be combined and overlaid on X-ray images.

The strict standardization of the projection geometry with serial
X-rays, combined with image processing, may lead to a much more
sensitive detection and quantification of light tissue changes.
- The study, which covered a 5 year period, proved that oral
implants may be inserted and maintained in patients with or without a
history of periodontal disease.
- The patients with a history of periodontal disease exhibited a
lower implant survival rate (90.5% vs. 96.5%), a higher complications
rate (28.6% vs. 5.8%) and hence a lower success rate (71.4% vs. 94.5%) as
compared to the other patients whose edentulousness was caused by
other factors than periodontal conditions.
- The survival rate of implants replacing dental losses due to
periodontal factors was 90.5%, whereas the survival rate of implant
replacing teeth lost due to other causes (caries, fractures, injuries) was
96.5%. As one may notice, the failure rate in group A was 9.5% and in
group B 3.5%. This is not a statistically significant difference, as the
difference between the survival standards is obvious, especially after 6
years of implant use.
- According to the two statistical methods that we used, smoking
had a considerable influence on early implant failures.
- Certain factors like hypertension, ischemic diseases, osteoporosis, hypo and hyperthyroidism, type II diabetes, rheumatoid
arthritis, hypercholesterolemia, antidepressants and steroid medication, did not increase early failure incidence.
- The results show very good sample behavior in the testing
solution both to corrosion and electro-corrosion.
- As far as the microstructure is concerned, we detected no
micro-fissures, “pitting” effects, pores or exfoliations of the coat
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- There are numerous therapeutic solutions for edentulous patients, therefore the right choice should be done judicially, considering the specificity of each patient and in full agreement with the requirements of each case, and subject to the technological limitations that the dentist is sometimes faced with.

- The negative clinical-biological indices occurring in the prosthetic field limit considerably the therapeutic solutions available, the best of which is actually a compromise between the optimal approaches, which allows failing system rehabilitation.

- A full and accurate assessment of the prosthetic field is absolutely essential when making therapeutic choices, yet one must not be oblivious to the social and economic implications of each case which, beyond the admirable prosthetic restoration solutions available, are decisive when choosing a therapeutic approach.

- Outpatient follow-up is extremely important since, although the prosthetic solutions adopted admirably restore the harmony of the entire maxilla-facial area affected by edentulousness, changes may
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