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Research Article

The Clinical Evaluation of Dental Implants with Nano Surface

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Abstract:

The diagnosis of nanodiagnosis it is the use of nanodevices in an early detection at the cellular and molecular levels of diseases or their predestination. With In-vitro diagnostics, in order to evaluate the early existence of a disease, classify and quantify toxic molecules, tumeor cells or infectious diseases, nanotechnologies may improve the efficiency and sensitivity of diagnostic approaches by means of fluids such as saliva or tissue samples in which selective nanoscales perform multiple analyses on the subcellular scale. In the dental interest, the high mortality rate of oral squamous cell carcinoma is often attributed to difficulties in detecting the disease at an early treatable stage. In recent years, the ability of gold nanoparticles subjected to surface plasmon resonance capable of causing an optical contrast to discriminate between cancer and normal cells, and their conjugation with antibodies, has been explored, allowing the expression of relevant biomarkers to be traced for molecular imaging in the reflectance confocal microscope, demonstrating its potential for cancer detection in reflection based imaging systems on the basis of biomolecular changes.

Local anaesthesia: Local anaesthesia is one of the most common dental procedures. In recent years the development of bio-compatible microsphere and nanospheric drug regulated devices has turned them into ideal tools to use such anaesthetic substances to increase their protection, thereby reducing their physiologically harmful effects and reducing their effects by lacking vasoconstricting substances.

Keywords: Clinical Evaluation, Dental Implants, Nano surface.

Introduction

The presence of dentine and dental cells, such as gingival fibroblast, LCD pulp or cementoblast, bacteria within the dentine tubule, odontoblast near the pulp and pulp- or lamina-own boundary, indicates that the cell-sized nanorobotic movement of this sort must be practicable. When installed into a pulp, nerve impulse control can be operated by a simple computer command handled by the dentist, which blocks all sensitivity of any tooth that needs treatment (i). The dentist will order the nanorobot to restorate all sensations after the required procedures have been completed. This nanorobotic technology gives the patient greater convenience, reduces their discomfort and allows more selectivity without needles to handle the analgesic effect, function rapidly and be totally reversible to prevent side effects and complications (ii).

Repair of tooth. A bio-autologous substitution tooth with both mineral and cellular components - replacing the entire dentition - should be made and built with nanorobics, and this should be possible in due course in time. The replacement therapy is possible. Nancollas, et al (2011) simulated a natural biomineralization technique to create human body hardest tissue dental enamel, by using highly ordered units of calcium nanoparticles of crystals arranged in parallel, simulating the nearly microarchitectural perfection of natural enamel. Nancollas, et al (2011). Hypersensitivity to the tooth. Hypersensitive teeth have an eight times higher surface density than a healthy tooth with dentine tubules and a two times tube diameter of non-sensitive teeth. Nanorobots able to selectively and precisely use native biology material will seal special tubules within a matter of minutes, providing a quick and permanent treatment to patients for hypersensitivity. Nanorobots can control the parodontic tissues in orthodontic treatments directly by repositioning their dents, allowing both rotating and vertical relocations to straighten the teeth easily and without pain within a matter of minutes or hours ([iii]).

Dental renaturation: this technique may deliver ideal cosmetic dentistry treatments. This trend will start with those who wish to have their teeth previously filled or reconstructed with artificial dentals such as amalgams or polymer resins, which are now reconstructed with organic biological materials, and full coronary resinating procedures in which polymer resins, crowns and other modifications are indistinguishable from the treated tooth of a 20th century

Longevity of dental and cosmetic. The consistency and appearance of the tooth can be enhanced by adjusting the top layer of the enamel from covenant-bundled artificial materials like saphir or diamond with an average hardness and enamel strength of 20 to 100 times, the physical insufficiency and excellent biocompatibility of the new ceramic veneers. Pure saphire and diamonds are fragile and fracture-prone, but as a composite nano-structured material that contains carbon nanomethubes they can be made more fracture resistant ([iv]).

Dentifrobots provided with a bite or toothpaste could patroll at least once daily all surfaces of supragingives and subgingival, metabolising organic trapped matter and in combination with continuous debridging of dental calculus. In order to support a healthy environment, properly confectioned toothpieces can by comparison, recognise and kill pathogenic plaque and other pathogenic bacteria and 500 species of harmless oral microflora. Dentifrobots will also be an ongoing hindrance to halitosis, since the key metabolic procedure of oral malodor is bacterial putrefaction. Dental treatment of that kind will delete from the medical history annals every day after a young age dental caries and traditional disorders involving the safety and incorporation of periodontium ([v]).

Another potential advantage of nanotechns is their ability to take advantage of material atomic or molecular properties so that new materials with better properties can be produced. For example, the properties of various fibres have been enhanced by nanotechnology. Polymer nanofibers with a nanometric diameter have a wider area per unit mass, allowing for simple functional attachment over the surface of microfiber polymers. Regulated released structures, which reflect a true structural support for fabric and filtering engineation, were investigated as polymer nanofibre materials ([vi]). Carbon fibres with nanometric diameters display a select rise in osteoblast adhesion due to their high degree of nanometric ruggedness, which is important for effective orthopaedic and dental implant applications ([vii]).

This type of surface treatment consists of heterogeneous precipitation of calcium phosphate under physiological conditions of temperature and pH on the dental implant, through the use of ions solution similar to blood plasma with a view to depositing the apatite layer. Once the molecules are integrated into the material's structure, they are gradually released, thus being able to increase osseoconductivity and potentiate the formation of bone around the implant. Calcium phosphate today presents itself as one of the main biomaterials for bone tissue replacement and regeneration, as it has the following characteristics: similarity with the mineral phase of bone tissue, teeth and calcified tissues; excellent biocompatibility; bioactivity; absence of toxicity; variable degradation rates; osteoconductivity. Another advantage of this surface treatment is that biologically active molecules, such as osteogenic agents, can be precipitated as inorganic components to form a matrix with both osteoinductive (growth factors) and osteoconductive (calcium phosphate layer) properties ([viii]).

Nanotechnology and nano-dentistry

The prefix "nano" comes from the Greek and means "dwarf". Usually the word nanoscience is used to refer to the study of phenomena and the handling of matter at the nanometric scale (a nanometer is one millionth of a millimeter; a nano = 0.000000001), while nanotechnology is in charge of the study, creation, design, synthesis, identification, manipulation and application of materials, devices and systems through the control of matter in dimensions close to the 1-100 nanometer range, as well as the exploration of phenomena and properties of matter at said scale. Nanotechnology includes electronics and magnetism, for the manufacture of structures of carbon, silicon, inorganic materials, metals and semiconductor materials. Likewise, it also intervenes in the design of biological systems, including genetic material. Molecular nanotechnology generates functional materials through physicochemical techniques ([ix]).

In this sense, nano-dentistry is the dental application of nanotechnology, which will allow the use of useful research instruments, new pathways and advanced mechanisms for releasing molecules and / or drugs, for the repair of damaged tissues. Chronology of events that marked the emergence of nanotechnology Richard Feynman (1959), was the first to make reference to the possibilities of nanoscience and nanotechnology in his speech he gave at the California Institute of Technology, entitled "In the background there is space ample". He won the Nobel Prize in physics in 1965 for his work on quantum electrodynamics ([x]). Eric Drexler, founder of the Foresight Institute (1980), first introduced the term “nanotechnology”. Gerd Binning and Heinrich Rohrer, designed and manufactured the tunneling microscope (Nobel Prize in Physics, 1986). This basically consists of visualizing atoms as independent entities. The current is one nano-ampere (0.000000001 amps) when using a millivolt voltage. The microscope works in an immediate field, at a distance of two or three atoms from the surface. After this discovery and based on a similar principle, another series of microscopes have been perfected that have the objective of working with nanometric measurements. With all these advances, today dental specialists have a great interest in continuing to investigate more about molecules or organic materials called "biomaterials", which are elements compatible with the human body that are used to build artificial organs, systems of rehabilitation, prosthetics or to replace injured tissues. Likewise, implement the application of nanotechnological methods and techniques to find therapeutic alternatives, or the creation of nano-designed structures for drug delivery ([xi]).

Therapeutic prospects of nano-dentistry Nano-dentistry can establish as a purpose the control, tracking, construction, repair, protection and improvement of oral functioning. In this context, nano-dentistry makes use of suitable nanometric systems to be integrated into micro-devices or a biological medium, to perform a specific function. Dentists could induce anesthesia by placing a colloidal suspension containing millions of nanometric analgesic particles on top of the gingiva of the patient (Figure 1). Immediately after contact with the crown or with the mucosa, the nanorobots would reach the dentin and penetrate from the dentinal tubules that have a diameter of 1.4 μm to the pulp, driven by a mixture of chemical gradients, temperature differences and all under the control of nanocomputers. This is feasible because there is a distance of approximately 10 mm that covers the entire surface of the tooth and if the nanorobots were to move at a speed of 100 μm per second they would complete their journey in the pulp chamber in approximately 100 seconds.

The creation of nanorobotic toothpastes with a dimension between 1-10 μm, released by rinses or toothpastes at a concentration of 103-105 nanodevices per oral cavity; and that contain drugs genetically designed against pathogens, mainly against Streptococcus mutans, this would become a vaccine against dental caries. Likewise, the "dentifricorobots" would be configured to identify and destroy other pathogenic bacteria resident in the oral cavity that cause halitosis and periodontopathies; but it will respect around 500 species of harmless bacteria or saprophytes of the microflora. Tissue regeneration with genetically engineered drugs, would allow the manufacture of teeth in the dental office In the same way, the replacement of resins, amalgams and another type of tooth reconstruction material using biomaterials (12).

The hypersensitivity of dentin is caused by changes in the hydrodynamic pressure transmitted to the pulp and as the tubules of sensitive teeth are eight times more abundant and their diameter is double, compared to the tubules of non-sensitive teeth, nanorobots would be able to carry Specific biomaterials to clog the tubules, offering a definitive cure. The nano-filler materials would be used as matrix monomers for dental reconstructions. These compounds would decrease polymerization shrinkage, improve strength and biocompatibility. With the design and manufacture of orthodontic nanorobots, periodontal tissues, gingiva, ligament, cementum and alveolar bone could be controlled; In order to achieve rapid tooth movement from minutes to hours and without pain, through the use of dermal patches. With the use of these nanotechnological techniques, the biomechanical control of force would be allowed, and it would be possible to develop active markers that recognize the marking of specific areas of genetically modified cells in the microvasculature of the periodontal ligament. With these nanotechnological techniques, the appearance and durability of teeth can be improved by replacing the upper layers of enamel with covalent bonds of artificial materials such as sapphire or diamond, giving it a strength between 20 and 100 times greater than that of natural enamel.

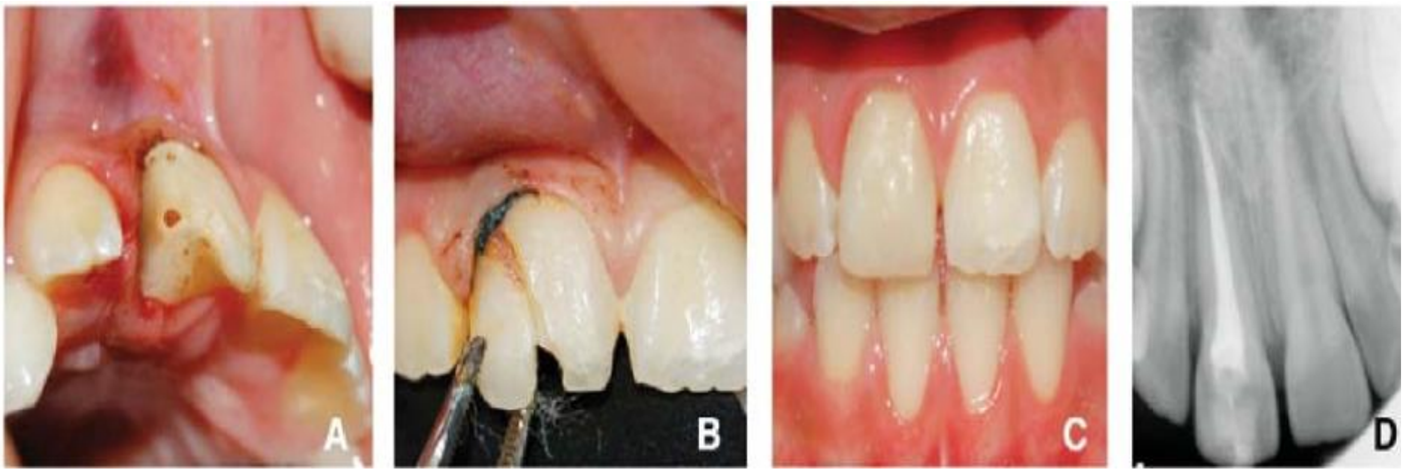

Figure 1 : With the synthesis and use of native biomaterials of the tooth, a faster dental reconstruction will be possible. A. Diagonal dental fracture of the upper right central incisor of an 8-year-old girl, resulting from a fall. B. Process of dental repair of the injured tooth. C. Radiograph showing the complete apexification process

Objectives

Taking into account the experimental and clinical research regarding implants with nanometric surface, the objectives of the following work are:

1. Assessment of patients treated with nanosurface implants.
2. The evaluation of the surgical and implantological aspects of the treatment with this type of implant and surface.
3. The evaluation of the protocol in the various clinical situations of unitary, partial and total edentulism, with the various prosthodontic treatments (unitary crowns, fixed bridges, fixed rehabilitation and overdentures) on osseointegrated implants.

Materials and Methods

The present study has been carried out in the Teaching Units of Integrated Adult Dentistry in the teaching hospital of Baghdad University during the period of Jan 2021- April 2022. (Figures 1 and 2). The study protocol was accepted by the Ethics Committee of the Baghdad University.

Figure 1: Baghdad Medical City, Figure 2: College of Dentistry

Before conducting the study, those patients who suffered from serious systemic disorders that could compromise Osseo integration were excluded from the study. The selected patients were adults of both sexes. All patients presented some unitary, partial or total dental loss. All patients selected in the study were informed of the implant treatment protocol, surgical and prosthetic aspects, the timing of treatment and follow-up, as well as the possibility of the existence of complications and the loss of implants. The patients authorized the implant treatment by means of an informed consent.

In patients with unitary, partial or total tooth loss for rehabilitation with crowns, partial or total fixed prosthesis, a surgical splint was previously performed for the insertion of the implants.

All patients were evaluated radiologically, with an Orthopantomography or Panoramic Radiography (Figure 3). In those necessary cases, a Cone Beam Tomography was performed (Figure 4).

Figure 3

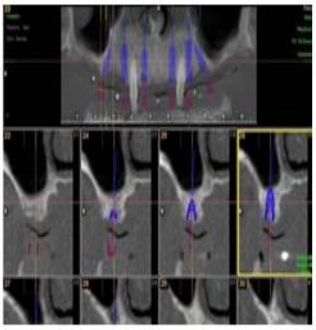

Figure 4

Methods

The present study consisted of rehabilitation with oral implants in patients with some degree of dental loss, unit, partial or total. The patients were treated with threaded implants with a sandblasted and etched titanium surface with a nanometric structure and early functional loading protocols were applied after insertion, at 6 weeks in the mandible and 8 weeks in the maxilla. The present study was carried out in those patients with some degree of dental loss that did not include the performance of the most complex implant surgical procedures (such as, for example, tissue regeneration, bone grafts, growth factors).

Surgery

One hour before surgery, the patients began a preventive antibiotic regimen (amoxicillin + clavulanate) that lasted one week. All patients received local anesthesia. All patients performed the daily chlorhexidine rinse for the first 30 days.

Galimplant ® implants (Galimplant, Sarria, Spain) with nanosurface, Nanoblast ®, obtained by sandblasting and acid etching were inserted in all patients (Figures 5 and 6).

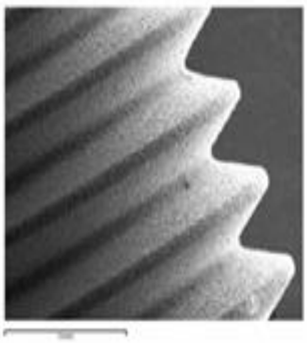

Figure 5

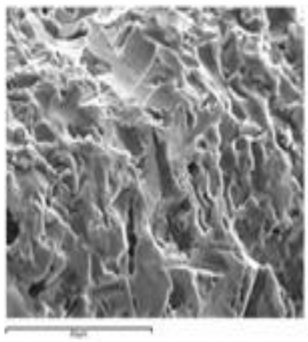

Figure 6

Bed preparation and implant insertion were carried out according to the conventional standardized protocol with consecutive drills from smaller to larger diameter, at a constant speed of 800 rpm (Figures 7 and 8).

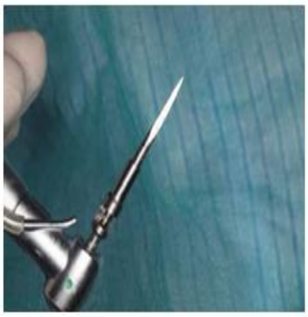

Figure 7

Figure 8

The basic surgical procedure consisted of a mid supracrestal incision, in the unitary, partial or total edentulous section (Figures 9 and 10). All implants were stable after insertion. The soft tissues were sutured around the healing screws (1 surgery). After a week the sutures were removed.

Figure 9

Figure 10

Prosthetics

The functional loading of the implants was performed according to an established implant protocol of early loading after insertion at 6 weeks in the mandible and 8 weeks in the maxilla (Figures 11 and 12). The elapsed time of clinical follow-up from the functional load of all implants was at least 18 months).

Figure 11

Figure 12

Single crowns

In patients with unitary dental losses in the posterior sector, no provisional removable unitary prosthesis was performed. Edentulous patients with unitary dental losses in the anterior sector underwent a remodelling of their removable unitary prosthesis so that it did not occlusally affect the inserted implant until the implant-supported prosthodontic procedure was performed. At 6 weeks in the lower jaw and at 8 weeks in the upper jaw, after insertion of the implants, early functional loading of the implants was performed by placing a single crown (Figures 13 and 14).

Figure 13

Figure 14

Success Criteria

The implant success and survival criteria were those recommended by van Steenberghe et al. 199. In this sense, survival was defined as the proportion of permanent implants in their original location even if they have no clinical value or cause adverse effects.

The success criteria for implant treatment were the following 199:

1. The implant does not cause any local or systemic allergic, toxic or infectious reaction.
2. The implant offers support for a functional prosthesis.
3. The implant shows no signs of fracture or bowing.
4. The implant does not show any mobility when it is scanned manually or electronically.
5. The implant does not show any signs of radiolucency on an intraoral radiograph.
6. Marginal bone loss (intraoral radiography) and / or insertion loss (probing depth + recession) must not impair the anchoring function of the implant or cause discomfort to the patient.

Statistical Analysis

Descriptive statistics were performed on the clinical findings of the study, with reference to the demographic variables of the patients, the characteristics of the implants (survival, success, complications and losses) as well as the early functional load and the prosthodontic restorations performed (single crowns, fixed and total partial dentures, overdentures).

All the previous variables were statistically analyzed. Qualitative variables were analyzed according to the chi-square test, while quantitative variables were analyzed according to the variance test.

For the analysis of the numerical variables that did not follow a normal distribution, the non-parametric Mann-Whitney U test was used, and if there were more than two groups, the Kruskal-Wallis test.

Results and Discussion

Patients

A total of 168 patients with unitary, partial or total tooth loss were treated with dental implants with nanometric surface obtained by sandblasting and acid etching on titanium for their rehabilitation with their corresponding prosthesis.

Age and Sex

The mean age of the treated patients was 39.7 years (range: 18 -69 years). 37 patients (22%) were under 30 years old, 65 patients (38.7%) were between 31 and 45 years old, while 66 patients (39.3%) were over 45 years old (Table 1).

Table 1 DEMOGRAPHIC VARIABLES

Age	<30 years	31-45 years	> 45 years	Total
	37 (22%)	65 (38.7%)	66 (39.3%)	168 (100%)
Sex	Men	Women		Total
	65 (38.7%)	103 (61.3%)		168 (100%)

Among the 168 patients, 103 were women (61.3%) and 65 were men (38.7%). There were no significant differences when relating the categorized age and the sex of the patients (chi-square test; $p = 0.25515$) (Table 1).

Implants

Type of Implants

All patients (100%) were treated with nanosurface implants.

Number of Implants

A total of 364 implants were inserted in the corresponding 168 patients, representing an average of 1.9 implants per patient (range: 1-6) (Table 2).

Length of the Implants

364 implants were inserted, 199 implants (54.7%) were 12 mm in length, 159 implants (43.7%) were 10 mm in length and 6 implants (1.6%) were 8 mm in length (Table 3).

Diameter of Implants

Regarding the diameter of the implants, 44 implants (12.1%) were of reduced diameter (3.5 mm); 279 implants (76.6%) were of universal diameter (4 mm); while 41 implants (11.3%) were of wide diameter (5 mm) (Table 2).

Table 2: DISTRIBUTION OF IMPLANTS ACCORDING TO THEIR LENGTH AND DIAMETER

LENGTH	8 mm	10 mm	12 mm	Total
	6 (1.6%)	159 (43.7%)	199 (54.7%)	364 (100%)
DIAMETER	3.5mm	4 mm	5 mm	Total
	44 (12.1%)	279 (76.6%)	41 (11.3%)	364 (100%)

Type of Implants Insertion

All implants (100%) were inserted delayed (at least 6 months) after the corresponding extraction.

Surgical Technique

The surgical procedure consisted of a mid supracrestal incision, in the unitary, partial or total edentulous section (Figures 1-18). The preparation and drilling of the site and the insertion of the implants were carried out according to the conventional standardized protocol.

Single implants (Figures 1-6).

Figure 1

Figure 2

Figure 3

Figure 4

Figure 5

Figure 6

Multiple implants (Figures 7-12).

Figure 7

Figure 8

Figure 9

Figure 10

Figure 11

Figure 12

Implants for overdentures (Figures 13-18).

Figure 13

Figure 14

Figure 15

Figure 16

Figure 17

Figure 18

The results of the present study indicate that the use of dental implants with nanosurface represent a good implant option since they manage to establish a favorable response of the peri-implant hard and soft tissues and offer a very adequate stability for their functional load. These favorable clinical findings represent the result of the integration of several implantological factors that will be discussed in this chapter of the thesis. First, an adequate selection of patients has been made according to their systemic and oral assessment that does not compromise implant treatment from a biological perspective. Second, a protocolized surgical technique has been performed, under suitable bone conditions that did not require other more complex techniques (eg biomaterials, regeneration, etc). Third, dental implants with a suitable morphology for their primary stability and a nanometric surface have been used to improve bone-implant bonding. And fourthly, the corresponding functional load has been performed with a prosthetic technique that allows the various treatment solutions to be carried out in the rehabilitation of patients.

Patients

The present study has been carried out in 168 patients who presented some partial or total dental loss. 103 women and 65 men with a mean age of around 40 years.

Due to the clinical characteristics of the research study, patients with no significant medical history that could compromise osseointegration were selected. In other words, those suffering from acute or chronic diseases or conditions that could complicate or contraindicate implant treatment were excluded. In this way, an attempt has been made to minimize the possible general or systemic risks of implant treatment ([xii]).

Systemic or medical conditions such as diabetes and tobacco use have long been considered important risk factors that could compromise implant survival and therefore the presence of these conditions in certain patients did not consider them acceptable candidates for implantation. treatment with implants ([xiii]).

However, a better understanding of the biological response to implant insertion and the clinical experience of their use in this type of patient has been consolidating better decision-making in the comprehensive assessment of implant patients suffering from acute or chronic diseases and / or consume certain types of medications ([xiv]).

In the present study, approximately 15% of the patients had some medical history, especially hypertension and diabetes. These two diseases are very common in the general adult population ([xv]).

Cardiovascular history has not been highly valued in relation to dental implant treatment. It should not be forgotten that many drugs used for hypertension and cardiovascular diseases can present oral adverse effects (eg xerostomia, dysgeusia, lichenoid reaction) that may make it necessary to modify the treatment plan, especially surgical (eg anticoagulants), antiplatelet) ([xvi]).

A Canadian retrospective study ([xvii]) evaluates the outcome of 4591 patients treated with implants. 39 suffered from cardiovascular disorders (arterial hypertension, acute myocardial infarction and angina pectoris) (Group I), 98 were healthy (Group II) and 109 suffered from other general diseases (Group III). The failures were 12.8%, 12.2% and 13.8%, respectively, without significant differences. The results of this study suggest that cardiovascular diseases are not an absolute contraindication to treatment with osseointegrated implants and do not increase possible failures.

A recent study assesses the results of implant treatment in Korean patients older than 70 years, where 82.8% had systemic diseases, especially arterial hypertension. Treatment success after a mean period of 32.7 months was 95.8%, confirming that controlled systemic diseases do not affect the success rate of implants ([xviii]).

As for diabetes, if it is not controlled it can negatively impact bone metabolism and affect the necessary osseointegration required for the success of dental implants. A recent North American study confirms that diabetes is a risk factor for implant failure and the concept that hyperglycemia has a deleterious effect on bone health. In fact, the retrospective study carried out on 341 implants shows that implants inserted in a patient with diabetes are 2.6 times more likely to fail than implants placed in patients without diabetes 204.

In Israel, a study ([xix]) was carried out that evaluated some systemic risk factors (tobacco, diabetes) and local (history of periodontitis) associated with the survival of dental implants 205. In retrospect, 1626 implants inserted in 475 patients were evaluated. The failure rate was 4.7%; 77 implants failed. 10.3% of the patients were diabetic and had a lower failure rate of 2.8% out of 177 implants inserted. However, with respect to tobacco, 13.3% of the patients were smokers and had a higher failure rate (9.3% of 226 implants).

In the present research study, 16.1% of the patients were smokers, although there was no significant relationship between this risk factor and the incidence of implant failure. However, a negative influence of tobacco on osseointegration and on the appearance of peri-implantitis has been demonstrated. A Spanish study carried out with 173 implants in 50 patients confirms the possible relationship as a risk factor of tobacco in implant treatment. 56% of the patients were smokers. Smokers presented more complications than non-smokers (39.5% vs 22.7%); more peri-implantitis (10.7% vs 4.5%) and a higher percentage of failures (17.8% vs 4.5%), although not significantly.

Implants

In recent years, experimental and clinical research has made great efforts to improve the bone-implant interface, with the aim of accelerating bone healing and improving bone-to-implant bonding ([xx]). The first strategy tries to improve the bone-implant union, chemically, incorporating inorganic phases such as calcium phosphate or in the titanium oxide layer. These inorganic modifications could stimulate bone regeneration and increase the entanglement between the bone's protein matrix and the surface of the material. Currently, modifications of biochemical surfaces is a variant of this first strategy and refers to the incorporation of molecules such as proteins, enzymes or peptides that induce a specific response of the cell and tissues.

In the second strategy, the interface is physically enhanced through the architecture of the surface topography. At the micrometric level, the reasoning for this approach is that the rough surface presents an area of greater development compared to the machined surface and consequently increases bone bonding and biomechanically reinforces bone-implant crossover, at least up to a certain **level of roughness.**

At the nano level, roughness increases the surface energy and consequently improves the adsorption of the protein matrix, the migration and proliferation of bone cells and finally osseointegration. During the last thirty years, many techniques have been developed with the aim of improving osseointegration from a physical and chemical point of view. The first osseointegrated surfaces were manufactured with an industrial machining on the titanium implant, which had a minimum surface roughness with some periodic microgroove ([xxi]).

Despite the clinical success of these machined surfaces, other processes have been developed to improve the microtopography of the surface using for example titanium plasma spray, acid etching or sandblasting. Acid etching is often performed with hydrofluoric, nitric, or sulfuric acid or a combination of both. Sandblasting is carried out by spraying silica (sandblasting), hydroxyapatite, alumina or TiO_2 particles and commonly accompanies acid etching to homogenize the implant surface and remove as much as possible blasting residues ([xxii]).

Many engineering processes can combine chemical and physical modifications to the implant surface. For example, the electrochemical anodization of the titanium surface can promote a thickening of the micrometric scale and in an ionic impregnation of the TiO_2 layer, where the collapse of the material surface results in porous structures and associated with micro- and nanotopography ([xxiii]).

Conclusion

1. The comprehensive diagnosis of the implant patient with partial or total edentulism constitutes an essential requirement for the treatment with dental implants with nanosurface.
2. The basic surgical technique using a standardized a traumatic drilling protocol constitutes an excellent method for the insertion of nanosurface implants in the appropriate bone conditions.
3. The rough nano-scale surface obtained by subtraction through the action of sandblasting and acid etching establishes a bone-implant bond with clinical evidence and favours the possibility of carrying out an early functional load.
4. The early functional load of nanosurface implants represents a successful clinical protocol in the different prosthetic options in the treatment of patients with tooth loss.
5. The clinical follow-up of the present study shows that comprehensive treatment with nanosurface implants can be successfully maintained in the medium term.
6. The clinical evaluation of patients with partial and total edentulism treated globally with nanosurface implants has been highly successful and constitutes a current alternative for implant treatment.

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