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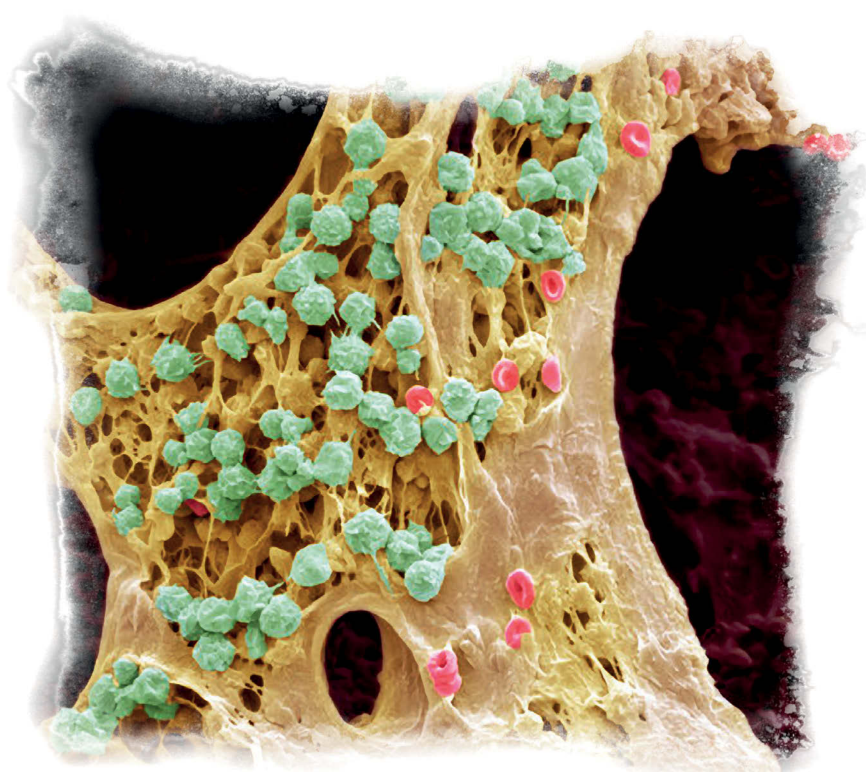

"arte e ciência imitam a vida"

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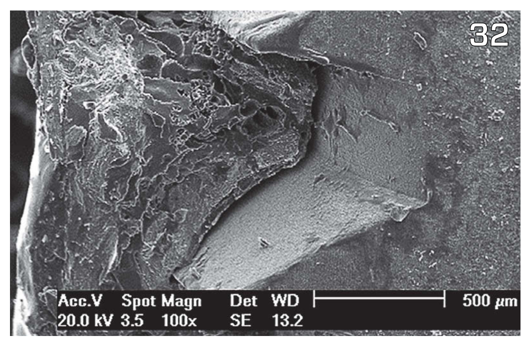
Interview

Image and Science



Explanations and Applications

Ask the Expert

Observatory

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Biology, combined with technology, increasingly provides options for Implantology to grow in its techniques and possibilities, offering patients proper oral rehabilitation, even if they present systemic problems such as diabetes mellitus, syndromes such as ectodermal dysplasia, anodontias and other edentulism situations.

In each issue of this journal, we have new approaches on biomaterials, maxillary sinus lifting, distraction osteogenesis and also about the best time to implant placement with or without immediate loading.

Technical possibilities are extended and a systematic reading of the articles is mandatory for constant updating not only for the clinician, but especially for those who research and teach Implantology. In the modern world there is no longer place for professionals highly specialized in one field of knowledge: Interact with other specialties and their possibilities is a requirement of how Implantology advances, crossing up with other areas.

The increasing presence of Brazilians abroad, researching and coming back to the country with new possibilities, further enriches our Dentistry. Like a strategic plan, the constant presence of Brazilians in prominent places at the best universities in the world – such as Luiz Meirelles, the interviewee of this issue - open spaces so that other fellows may transit in laboratories and clinics with different approach of world's Implantology, enriching our specialty in the context of Brazilian Dentistry.

This interview will allow us to know a little better this notable Brazilian, take his life experience as an example and perhaps interact with him for new enriching contacts, including in the federal program "Science without borders".

Let us take it!

Prof. Alberto Consolaro


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Luiz Meirelles

Many Brazilians dream of studying abroad. Perhaps to build a career in another country or just to make a true contribution for Brazil in the field of science and technology. What if this contribution positively affects the improvement of a product that benefits hundreds of patients? In this case, we would be talking about a young prodigy named Luiz Augusto Meirelles who gave us this amazing interview. It was in 2007 that we had the grateful surprise to meet Luiz. We organized a group of people that went to Gothenburg, Sweden, to participate of the first Brazilian Day (Dental Press Magazine, Periodontics Implantology, v. 1, n. 3, p. 110-111, jul./aug./sep. 2007). We had many lectures given by professors from Sweden and Brazil, in a scientific exchange very beneficial to our team. On the following day, we watched the interviewee's thesis defense. Actually we saw a young man to be truly massacred with objective questions, sometimes aggressive, from his accuser (Professor Lyndon Cooper, USA), regarding his works in surfaces of implants, especially in nanotopography. However, for our joy, he not only did very well, but also was applauded by his compatriots and by the Swedes present at the end of the works. Today we have a friend who exercises the teaching and researching at the University of Rochester, in the U.S., and that at 37 years of age is already quoted by the most renowned researchers, as one of the world's leading authorities in the field of surfaces of osseointegrated implants. Luiz Meirelles graduated in Dentistry in 1998 at the Federal University of Rio de Janeiro and worked in different research projects in the area of osseointegration during scientific initiation. In 2001 he started the master's degree at the Faculty of Piracicaba (Unicamp), analyzing the distribution of stress on implants through a photoelastic analysis. He concluded the program in March of 2003 and initiated the doctorate at the University of Gothenburg in the same year. His doctorate program was focused in modifications on the surface of dental implants, characterizing the nanostructures with an innovator model. He defended his PhD thesis in 2007, being one of the pioneer researchers on the evaluation of bone response related to nanotopography. Today, he works at the University of Rochester as Assistant Professor of the Eastman Institute for Oral Health and the Faculty of Bioengineering. He is the head of a laboratory of research in biomaterials and works with patients in rehab. Luiz Meirelles is married and father of twin girls.

Luis Rogério Duarte

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How did you initiate the process of studies in osseointegration?

One day, walking by the Faculty of Odontology at UFRJ, I found an advertisement looking for an intern to work in a CAPES project with participation of Fiocruz, Military Institute of Engineering and Brazilian Institute of Implantology. The project was one of the first that evaluated the titanium dental implants produced in Brazil. The idea was to develop a national industry and make the Brazilian implants competitive in relation to the imported ones. The internship scholarship did not happen, but I, finding the project fantastic, offered to work anyway. It was my first contact with scientific research, on my second year in college. I met at this time the professors Carlos Nelson Elias and José Henrique Cavalcanti, among others that were part of this pioneer project.

Was there already a governmental policy thinking that it really was a scientific industrial development niche?

Of course. But the national industry, by that time, was initiating the manufacture of dental implants. There was already manufacture of prosthetic components, but implants were not yet a concrete reality accepted by everyone. There was a need on the market, the necessity to develop a national industry. Imported implants used to cost a very high price besides we suffered with storage and replacement of components. It was by this time that I started working with rabbits and animal experimentation at MIE and Fiocruz, between 1995 and 1996. I would go to Fundão's library after class and read and study about osseointegration. A lot of references from professors Brånemark and Albrektsson! I was impressed by that and on that moment I decided to study and learn with them. This was something already settled in my head.

What were your plans?

In 1999, on my first year as graduate I went to a congress in Denmark, at the European Academy of Osseointegration. By that moment, I had already decided I would doctorate in Gothenburg. I contacted some people by e-mail introducing myself and they said that there was a possibility but I would have to raise the money because they could not sponsor me.

So you had already contacted Gothenburg?

Yes. I sent an e-mail presenting my ideas for the doctorate program. Before the congress in Denmark (EAO, 1999), I exchanged e-mails with some researchers of the area, probing how it could be done. I had assistance from the professor Cláudio Fernandes and got to visit some universities in Scandinavia. This first contact was important and I got to define goals of what needed to be done. I visited the University of Gothenburg and talked to some people from the Department of Dental Prosthesis. Then I literally knocked on the door of Stig Karlsson — who was the head of Prosthesis — and said I wanted to work with implant. He said he had a person there that worked exactly with what I was talking about. I was introduced to professor Ann Wennerberg (my future supervisor) and, from this meeting, I already had some goals for my PhD. I went to Brazil and enrolled CAPES in 1999. My project and my resumé were approved but I did not get the scholarship under the argument that I was too young and did not have a master's degree.

Therefore, you decided to do the master's degree?

I did against my will, because no one in Brazil was doing what I wanted nor had technology to do it. When I was in Gothenburg, they found the idea very interesting, but said they did not have money. Actually, they did not want to sponsor someone they barely knew. I did the masters course at Unicamp, already intending to go to Gothenburg for PhD. By this time, I had already published some articles. I did a productive masters program, was an intern at Fundão for a good while, taught in remarkable places, published a lot and, sometimes, I would write to Ann Wennerberg saying that the project was still up and that as soon as I finished mastering, I would go there.

At this point you already felt Gothenburg's receptivity?

I never asked myself this question. I'm meeting Tomas Albrektsson, in Chicago next week, and I'm going to ask him that, it is an interesting question! When I was there, the impression I had was that they found me very determined.

What happened at the end of you masters program?

When I finished the masters course at Unicamp, I applied for full doctorate by CAPES and by CNPQ. CAPES approved the full doctorate and I had the chance to do it in Gothenburg. I defended my thesis at Unicamp in March of 2003. In September of 2003 I started my PhD.

Did Elias have any influence in all of this?

Professor Elias (Carlos Nelson Elias) is a prominent researcher and sent a recommendation letter. When someone like him gives a recommendation, saying I'm capable and have means to accomplish the doctorate, they consider it.

How was the beginning in Sweden?

To be honest, already in September of 2003 I took the project approved by CAPES, translated it to English, reformatted on the standards required by the University of Gothenburg and presented to Ann Wennerberg. This project would have to be accepted in the University of Gothenburg as a doctorate project. We did several alterations and, around this time, the professor Tomas Albrektsson started to participate in our meetings.

View of Rochester's downtown, divided by Genesee river.

Your doctorate research was in Osseointegration or Prosthesis?

It was a little bit of both. I wanted to evaluate the influence of micro-motion on the bone response. My idea was to determine that this value would probably change depending on the healing stage of the implant. It was an ambitious project for a masters thesis and, with the professor Altair Cury, we decided for an *in vitro* model, evaluating the distribution of stress between implants with external and internal connection, through photoelastic analysis.

Was there any Brazilians linked to Gothenburg by this time?

Not that I know of, but professor Maurício Araújo had defended his doctorate in the Periodontics department.

We talked a couple of times by phone before I moved there. He was very generous, giving me a lot of tips about the city, which tranquilized me.

What is the sensation of knowing you would work with professor Albrektsson?

The first time I set down to talk to him was a unique experience. I was a stranger, so in the beginning everyone was apprehensive. I would have to prove my purpose. They thought that four years was too short to finish and that I should start working immediately. One or two months after my arrival, the project was accepted as PhD thesis, although there, usually, it takes over fours years. Everyone was committed to me to finish within the deadline. Therefore, it all was very quick. Professional and efficient, Tomas Albrektsson is a rare personality. His reasoning is different, he evaluates everything through an angle we are not used to. It was a great learning and a very productive experience. Today I strive and try to focus on problems through this same angle. I'm not very sure if I succeed, but if I ask his opinion he will say I'm on the right direction. He always encourages you, making it clear that the process of professional maturity involves decision-making, right or wrong, it does not matter. It was amazing to listen, from a researcher like him, a very simple answer during the project discussion: "I don't know, we'll have to wait the results". Today, several innovations we are using were developed under Tomas' orientation. It is awesome to assess how his personal mark is present in several products.

Was it already in your plans to study nanotechnology?

No, my project would evaluate the biomechanics of bone-implant interface.

How was your first cultural adaptation?

In business hours, from 8am to 5pm, everything was great: I had my own office, my computer. They told me how to buy a laptop and how to start working on the project. I had a lot of trouble to find an apartment and little things became complicate for a newcomer. But I think this all is part of the growing process.

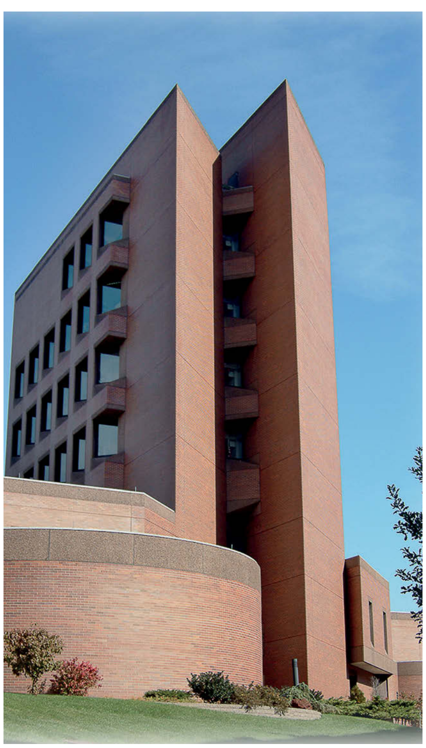
Do the rules for doctorate in Gothenburg are the same as in Brazil?

It depends on your dedication. There are professionals that do the doctorate in part time, a very interesting model. They are people who work at the university and can, in parallel, dedicate 50% to doctorate, still keeping their full salary. A lot of people do this and, therefore, the thesis there turn out so strong. You are paid and have time to read and study. There is always meetings of the research committee. Everyone discuss the ideas, it is a very good experience. In Brazil, it is rushed. You revise a doctorate thesis while having lunch, you take someone's thesis and it is coffee stained... It is too little support and too much dedication.

When did you enter the nanotechnology project?

In my first thesis article, I wanted to know the limit of vertical movement that would initiate the bone loss. Much of what was published in this area is with analysis of finite elements, which does not give the final biological answer; there are several limitations. There are a few works that were done in animals, but I'm not yet convinced of the values that are proposed. I think we must investigate it, especially if we consider the healing stage of the bone. My idea was to place the implant inside the rabbit's tibia, put loads with different degrees of strength and determine the limit acceptable by the implant. This was my first thesis article: I put a smooth implant, one loose and another tight. My idea, very simple, was to show that the loose implant would not osseointegrate; this would be the base of my other work, in which I would put different types of load on the implants that were loose. However, the loose implant formed more bone than the other, which I understood as coagulation disorder, where the loose implant would generate more bleeding and, therefore, a larger osseous callus. By the same time, between 2003 and 2004, the nanotechnology was emerging in the area of material science, with some potential advantages for bone formation. Professor Ann Wennerberg had an amazing history of microstructure assessment. Then, talking, it came up the hypothesis of use nanostructure in this model developed in the first article, being the perfect model for placement of nanostructure and evaluation of only its effects; for the stability was controlled independently of the surface. Anyway, the opportunity was a bit of luck: To be at the right time, in the right place, with the right model. At the same time, the evaluation of the implant's surface with atomic force that I developed was fundamental for my thesis, because with this analysis I could prove that nanostructure modifies the implant's surface, which nobody believed until then, simply because it was not visible to naked eyes. I proved that nanotopography changed and quantified each nanostructure. When you modify the microstructure, you can see; but the nano you cannot see to naked eyes. The struggle was to convince people. I showed my images and proved that there was alteration; it could be minor but there was. This was the great contribution: To characterize the nanostructure as I did and to prove it is related to topography, not only to chemistry.

In this conglomerate of building is the population service and the laboratories of medical research. There are many services, such as pharmacies and optical stores for the employees.



Medical Center of the University of Rochester.

How did you face us, Brazilians, watching your thesis defense?

At first, when Tomas told me, I thought this could distract me and I asked to defend in a different date from your visit because I feared too much interference and increase of the natural stress of the moment. I had invited professor Lyndon Cooper, despite the Swedes had warned me that Americans are very aggressive accusers, much more than the Swedes, that treat the moment more like a ceremony activity, not as a final test. But Lyndon Cooper said it was his son's birthday and he had promised not to miss this day anymore, thus, the dates ended up coinciding. So I convinced myself that there was no way and hoped there would not be any problems. It really was a great surprise, very nice people. Professor Elias was also there, whom I consider as living proof that genius and humility can be present in the same man. And the party afterward was great.

Tomas Albrektsson invited you to stay there as professor?

It was Ann Wennerberg, who was from Prosthesis Department who invited me to stay as Research Assistant. I stayed for about two years.

How did you decide to go to Rochester?

In the beginning it was not my idea to come here, but to stay in Gothenburg. But I decided to come for a greater project and lead my own laboratory. I think I was in a moment of my life that was moving towards this, to grow and be able to make the things I wanted. Despite my good relationship with everyone, I needed space to do my own things, and for that I had their total support.

Do you only work with Prosthesis or do you also do surgery?

I work in the clinic with Prosthesis and make researches applied in different animal models.

Today you are professor of Prosthesis or of Biomaterials?

I'm professor at the Faculty of Odontology, in the department of Prosthesis, and professor at the Faculty of Bioengineering. I work with biomaterials that are used for implants and for prosthesis. They are very close areas.

But your research is in the biomaterials area?

Yes, I have a laboratory with interferometer, atomic force microscope and all the equipment for histology. The same kind as they have in Sweden.

This way, it can be said that you have means to do research works in the same level as they do there?

Yes, this was a condition that I required to the university because I was at a certain stage in life where I could not stop publishing, I needed to continue my work. Therefore, in order to leave and come here I needed at least the same conditions I had there.

If it were here in Brazil, you would have to appeal to CAPES or to CNPq to try sponsoring the appliances. What about in the U.S., how does it work? Is there fomentation from the government or is it private?

There are both. Here there is a private university from the Ivy League, the American league for excellence in education. It is the greatest American private university of research. When they find a person with potential, they just go for it, here in the U.S. it works like this. If you come here to teach a class, stay for a week, research and show interest in staying and they identify potential in you, they will come for you.

How is it in the Rochester system? You teach, research, but also have time to practice?

The American university is very efficient to give return both to the professional and to the institution. For example, when I came here they asked me how they could financially provide my arrival. I said I liked to make prosthesis, that I wanted to go back to practice because I missed it since I did not use to practice in Gothenburg. I wanted to have my own laboratory of research and that I could also work with students which would be important for the school. My time would be distributed according to this. The American superior education is going through a great change.

Rush Rhees Library, in the background, and the Interfaith Chapel, in the foreground.

Today every professional in the universities has to justify their incomes; so, when a person is hired by a university, they will want to distribute the schedule making it productive. You teach, instruct the students in practice, make literature review and research, but also work in private practice to generate revenue for the department.

Do you have students of master's degree and doctorate?

I have one student of masters and one of doctorate, and I receive visitor students from many countries, from Brazil to Japan.

What are the results you already have from the new micro-nano surface from P.I. Brånemark Philosophy developed by you?

This project started in 2009. We did many tests to reach ideal parameters. Several characteristics were observed. There are many things about which I cannot extend for they were not yet published, showing that besides the characteristics of topography and chemistry — which are very interesting — it has a characteristic of surface integrity that is unique. We need to have the surface intact through all the process. It is the same line of reasoning from 1999, when I had the idea of the initial project, of studying the interface behavior, given that the surface also have a good performance when submitted to load.

What is the meaning, for Brazil, of the surface you have created and the effect this could have on global market of implants?

Brazil, today, is in growth phase, standing out in the whole world. But still lacks public and private investment on development of new ideas. The project of the new surface lasted many years and had investment from the company until the launching, with no immediate return. I accepted the job, believing we could make something innovator, instead of simply repeating what have already been used; a lower risk, but that would not bring anything new.

We have seen other countries investing in people for them to improve abroad and to return home bringing knowledge and technology to their nations. How do you see the Brazilian policy regarding this?

I cannot put this as responsibility of the Education Ministry or the Science and Technology Ministry. I think they are not the appropriated organs because they have to focus on educating an enormous layer of the population on secondary and high school. It could be a job for the organs of development such as Finep or investment funds to establish mechanism that provided laboratories of high technology in Brazil. Today, the partnerships are fundamental for the success of a project, but you cannot depend 100% on collaborators for your project to move on. A successful project depends on a great idea, adequate equipment and, of course, luck along the way.

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The bone reactional capability and the names of inflammatory bone diseases

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Renata Bianco **CONSOLARO****

Abstract
The bone reactions before functional demands and aggressions are different according to the local morphology, intensity and duration of the irritation and systemic state of the patient. In this work, initially it was sought to correlate these three important factors to comprehend the final result on the bone structure, especially from the imaging point of view. Then, it was presented the concepts of universally accepted names to identify inflammatory bone diseases, in order to facilitate the scientific and clinical communication between professionals.

Keywords: Osteitis. Osteomyelitis. Periostitis. Osteonecrosis.

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Introduction

The human skeleton is totally renewed in every 2 to 4 years in children and in 4 to 10 years in adults. The bone composition presents soft and mineralized tissues. The mineralized part of the bone is represented by cortical and trabeculae, in which are included osteoblasts, osteocytes and osteoclasts. The non-mineralized part of the bone are the periosteum, endosteum and the bone marrow, which fills the spaces delimited by bone trabeculae. The periosteum is constituted of a fibrous connective tissue densely collagenized in its external half while its inner half is intercalated by collagen fibers that enter and merge with the mineralized bone matrix of the cortical, fixating it tightly on the external bone surfaces. On the inner part, the interface with bone cortical, the periosteum is presented fully cellularized, with osteoblasts and clasts in abundance, as well as young cells, undifferentiated and even bone tissue stem cells or reserve cells. All the bone blood flow necessarily passes or go through the periosteum. The endosteum represents the inner and thinner analogue of the periosteum, located on the surface of trabeculae and inner parts of cortical. It is also constituted by connective tissue with few collagen fibers and rich in osteoblastic, reserve, lining and/or osteoprogenitor cells including bone tissue stem cells. The endosteum coats the bone trabeculae and naturally continues with the hematopoietic, fibrous and/or adipose tissue that fill the medullary spaces. The bone also presents as part of its structure the bone marrow, which can be hematopoietically active, when it is red; or inactive, when substituted by adipose or fibrous tissue, presenting a yellow or grayish white coloration. The mature bone cells are the osteoblasts, osteocytes and osteoclasts that, in syntony with other components, such as macrophages, promote bone remodeling and, at the same time, contribute to the performance of their functions in this tissue. On the bone remodeling process, besides the cells, three enzymes are fundamental and work as parameter to measure methabolic activity on human skeleton: acid phosphatase, located in osteoclasts, that also releases the collagenase, both involved in bone resorption; on the other hand, there is the alkaline phosphatase, located in osteoblasts and related to osteogenesis.

The bone tissue adaptive and reactive capacity

The bone adaptations to new situations and functions, resulting from its reactive capacity, and the inflammatory bone diseases are very important in the daily clinical practice of the implantodontist:

1. For the frequency.
2. For the sequelae resulting from its occurrance.
3. For the possibility of being resulting from important dental or implant alterations, but not noticed.
4. Because it can be due to professional interventions, such as bone surgery, inadequate therapy and lack of accurate identification of the patient's organic debility in anamnesis and systematic evaluation.

The bone reactive capacity and its resistance to stimuli or aggressors depend on three fundamental factors:

1) Local bone morphology

A spongy bone tissue more compact or dense presents small medullary spaces and provides little space for abundant inflammatory exudates. Very soon, any inflammatory process can increase the pressure inside the small medullary spaces, prematurely compressing the vessels, complicating the venous return and leading the medullary tissue to necrosis more quickly. A necrosed area of medullary tissue may be the ideal stage for bacterias to stay and form microbial biofilms. The bone tissue with sparser or loosely distributed trabeculae, before an aggression, provides more spaces for the inflammatory exudate and infiltrate, allowing a longer period which increases its denfense capacity for elimination of aggressors in the local. By logical deduction, it can be asserted that the bone tissue more compacted is a lot more physically strong, but biologically fragile for it demands the inflammatory process to work very quickly. The opposite occurs with the less compacted and more spongy bone: there is more time and space for inflammatory tools to fight the aggressors.

2) Intensity and duration of the aggression

The mild and continuous irritation, or referred as chronic, as well as all the aggressors, provides an initial acute inflammation, but quickly grows to mild or moderate chronic phase, with limited accumulation of mediators in the local. Many mediators of inflammatory exudate are inducers of bone resorption, but have bipolar effects: when in high concentration, induce prodominant clastic activity; but when in low levels in the same bone environment, induce the synthesis osteoblastic action with osteogenesis, being predominant on trabeculae and cortical surfaces. The mediators inducer of osteogenesis, on trabeculae and subperiosteal surfaces, gradually change the local bone morphology, that remains organized. As the irritation increases its harmful power, the osteogenesis may also occur but not so organized. The quick and intense irritation, or referred as acute, as well as all the aggressors, provides an initial acute inflammation, but a lot more exudative and rich in mediators inducer of bone resorption, and may induce necrosis areas of medullary tissue, endosteal and osteocytes. It can be asserted that mild or chronic irritations induce osteogenesis or bone reactions predominantly producer of synthesis phenomena, while the severe or acute aggressions cause resorptive, osteolytic or destructive bone reactions.

3) Systemic state of the host

The systemic state of the host can be determinant on bone reactions before aggressions. Generally, it can be noticed that the osteomyelitis occur only in patients systematically compromised or with wide sclerosing local bone diseases. The three most common causes of osteomyelitis in the organism are: (a) traumas with exposed fractures, (b) bone surgery in contamined environments and (c) proximity between bone and infectious focus in other tissues. On the maxillae, these three situations occur daily in thousands of people in the daily practice of Odontology, and the number of osteomyelitis do not stand out in relation to the other skeletal structures. When the patient is systematically normal, the same causes that would induce osteomyelitis promote osteitis – also an inflammatory process, however localizated and focused, with minor consequences, for osteolytic areas are limited and small, being predominant areas of bone sclerosis and the symptomatology is very low. The osteitis prognosis is very good.

After bone adaptations, the inflammatory diseases: nomenclature and concepts

The inflammatory or reactive bone diseases may represent the exhaustion of bone adaptive capacity before external ou internal aggressors. The terminology used to identify the inflammatory or reactive bone diseases is very important to standardize diagnosis, procedures, treatment and follow-up protocols. Before conceptualizing each one of the names used to identify the inflammatory or reactive diseases, it is very important to distinguish the terms "disease" and "lesion", since they have common use and different meanings. The diseases, or clinical entity, are evolutionary biological alterations and processes outside the functional and structural normality of tissues and organs. They are presented with specific and repeated pictures, that allow their identification and diagnosis by any qualified professional or habilitated for this job. These diseases induce transitory or permanent anatomic structural alterations on tissues and organs. These alterations are denominated "lesions". Lesion in any anatomic alteration whatsoever on tissues and organs, ie, represents a term of very wide use.

Inflammatory diseases can be nominated in their diagnosis as follows:

» Osteomyelitis: disease characterized by symptomatic bone inflammation of abrupt onset that can involve the three structural components – the mineralized part, the periosteum and the tissue components of medullary spaces.[2,7,8,10,15] Its origin is predominantely microbial but it can be physical or chemical. Generally the compromised bone area is wide and diffuse, with predominance of osteodestruction phenomena. The osteomyelitis hardly occurs in systematically healthy patients. Practically all cases have a base disease, such as diabetes mellitus, immunodepression, anemia, among others; or, the patient presents on the osteomyelitis area, an advanced sclerosing bone disease, such as florid cemento-osseous dysplasia, for example.

» Osteitis: disease characterized by asymptomatic inflammatory process that slowly can also involve the three bone structural components, but generally it is localized and with predominance of osteoproductive phenomena. [1,5,6,9,11,12,14,17] Generally its cause has low intensity and long duration.

» Periostitis: disease related to an inflammatory response of the periosteum before aggressors that work directly or indirectly on its structures. When the cause is acute or intense and work directly, it can be destructive and is part of other wider processes, such as dentoalveolar abscess and osteomyelitis. [4,13,16,18,19,20] However, when the cause is chronic, of low intensity and long duration on its structures, the involved periosteum reacts producing new layers of bone on the cortical surface, being nominate periostitis ossificans or productive, formerly also denominated, erroneously, Garrè's osteomyelitis.

» Osteoradionecrosis and Osteoradiomyelitis: they can be considered an specific or special variant of osteomyelitis in areas of osteonecrosis by radiation, almost always for therapeutic purposes in oncology.[3,10] The osteoradionecrosis, based in studies in animals, can be considered an state in which the irradiated bone, for some years, presents:

a) Chronic hypoxia, promoted by endoarteritis obliterans, complicating the passage of blood to the cells, for, in part, the vascular lumens are ocupped by the increase on thickness of the blood vessels inner wall.
b) Hypovascularization, for all the local cell population is reduced incluing the endothelial cells that constitute the inner layer of vessels.
c) Local hypocellularity in the irradiated area, for the mitotic index in the region is very low reducing its reparative or reactive capacity.
d) Death of osteocytes, very important cells on bone histophysiology. Each osteocyte connects to other 40 or 50 cells, making an intercommunicating network to trabeculae and cortical sur-

faces, thus controlling the bone shape, its subperiosteal responses and yet strongly influencing the local and systemic ionic balance.

For a period of 5 to 10 years, the irradiated bone tissue presents low defense and reactive capacity, at the same time it reduces its reparative potential. After this period, the irradiated region tend to go back to its previous reparative potential. In this bone conditions, the bacteria and other less aggressive aggressors find place and conditions to proliferate in this impaired bone structure and the inflammatory process becomes inefficient to contain them, establishing an acute and then chronic secondary suppurative osteomyelitis, also known by the name osteoradiomyelitis, although it is a hardy used term in literature. It seems logic to distinguish that osteoradionecrosis is the state of irradiated bone and osteoradiomyelitis corresponds to osteomyelitis or inflammation on the modified bone.

» Osteonecrosis: the increase of bone surgeries and the placement of bone integrable implants generalized the use of some terms not very used by clinicians until then, for example the osteonecrosis. Osteonecrosis can be conceptualized as death of the bone without infection, being induced by several factors as trauma, excessive heat, thrombus and plunger, radiation, graftings and chemical products.[3,10] Now the term necrosis, conceptually, should only be applied to cells, for it represents the cell death in a living organism without any genetic participation in its occurrance. The bone, as an anatomic organ, do not necrose, instead it becomes biologically unfeasible as a tissue in our organism context. Many agents can work on the bone and kill its cells, necrose them; if that happen to osteocytes, which are its inner cells and most protected by the mineralized matrix, it can be asserted that the bone is biologically unfeasible. It can be said that a bone without osteocytes needs to be entirely remodeled, it is without biological viability, must be resorbed and substituted by a new bone tissue rich in osteocytes. Physical agents, such as radiation and excessive heat, and chemical products can work on the bone tissue. Both types of aggressors may lead to necrosis of osteocytes and, therefore, these injuried areas may receive the name osteonecrosis, but not as a clinical entity or well defined disease. The death of osteocytes and/or an area with osteonecrosis induce on the bone periphery, and then on its interior, an inflammatory process localized and limited to a determined area and with low symptomatology. The bone tissue unviable by the death of osteocytes has certain aggressiviness to surrounding tissues, induces an inflammatory process not very much symptomatic and limited on this bone area, ie, induces an osteitis. In other words, the osteonecrosis induces and is resolved after an osteitis. After some days of aseptic inflammation on the local, or osteitis on spongy bone, it evolves to formation of granulation tissue, by the migration, proliferation and invasion of young neighboring endothelial and osteoblastic cells, permeating medullary spaces of the necrosed bone area. Gradually, the neoformed part substitutes the old part of the bone, substituting it entirely. In cortical osteonecrotic areas, the osteitis almost occurs in its interface and, gradually the clasts resorb and invade the small spaces and the neighboring osteoblasts are formed and interfer on the osteonecrotic area, mixing the old part with the new one, until all the osteonecrosed tissue is substituted. The formation of granulation tissue is too little and limited. The osteonecrosis and subsequent osteitis may interfer, retarding or impeding, the bone repair and bone integration. They are:

a) Osteonecrosis by local hyperthermia: situation in which part of the bone in a surgical area loses its viability by dehydration or denaturation, which means loss of water with coagulation of its proteins and loss of vigor of its cells. The generated heat may be by outworn surgical electric saw and milling cutters on the placement of implants. This tissue should be resorbed by the clasts to, then, be substituted by normal bone in a repair context. While it is not entirely resorbed, it will be infiltrated by polynuclear and mononuclear leukocytes, as well as by clasts. In the local, the inflammatory exudate ou edema will also be present, characterizing a chronic osteitis induced by excessive heat or local hyperthermia. Since the cause was eliminated with the surgery closure, the solution is to wait for the organism to repair the area and reassess the possible sequelae if apply.

b) Chemical osteonecrosis: eventually, chemical products may be poured on the bone environment, such as, for example, chlorinated soda used in endodontic irrigations. The acute inflammatory process may dilute the chemical substance, that in some days will disappear from the local. The local chronic osteitis, its macrophages, other phagocytes along with the clasts, will promote a cleansing of the area that gradually will be repaired as long as not secondarily contamined by bacteria. In many cases, this process was called chemical osteomyelitis, but the process is limited to the local and with no systemic participation, not justifying the use of the term osteomyelitis.

c) Drug induced osteonecrosis: term used to identify areas of bone unfeasibility that is said associated to use of bisphosphonates, especially in cancer patients. These drugs do not kill the osteocytes or other bone cells, as well as do not obliterate the vessels and not even depress the immune system.

However, cancer patients are systematically impaired, especially by the numerous and strong drugs they take as well as by the chemotherapy and radiotherapy they are subjected to. The patients become immunosuppressed, their tissues become hypovascularized and little cellularized. Any microorganism that reach the bone in this type of patient can induce pictures of suppurative osteomyelitis, which evolution leads to formation of fistulae and bone theft. The ingestion of bisphosphate represents more of a superposition on the situation than the initial cause of this osteonecrosis, although many surgeons insist in assign this type of problem in cancer patients to bisphosphonates – which in the biological and medical areas, is not valued. Cancer patients present several debilitating conditions, local and systematic, that increase their susceptibility to osteomyelitis.

Other terms widely used in bone biopathology

In the maxilla, systemic metabolic bone diseases hardly modify the trabelucae and cortical morphology, for the tax or speed of bone remodeling is very low. When it affects the maxilla the disease is in advanced or terminal stage. Long before this stage, other clinical problems made the patient seek medical care and orientation. Even though, some concepts about the bone state are important for frequently are used or mentioned when describing pathological conditions of all natures in the maxilla. They are:

1) Osteopenia: bone state characterized by thinner and shorter trabelulae and slender cortical, increasing the susceptibility to fractures. Several systemic metabolic bone diseases may promote this bone state very hard to show in the maxilla being more frequently diagnosed in long bones. It does not represent a disease but a bone state or condition.

2) Osteoporosis: state characterized by an osteopenic bone, when suffer subclinical or clinically diagnosed fractures. It can be asserted that osteopenia can evolve to osteoporosis but not necessarily. This term is necessarily related to presence of fractures on osteopenic bone.

The osteoporosis can be classified in primary, when post menopausal; and secondary when is due endocrine or kidney diseases. Other factors associated to osteoporosis are smoking, alcoholism, low calcium intake and surgical or precocious menopause. It does not represent a disease but a bone state or situation that can be induced by many diseases.

3) Osteomalacia: a bone state very characteristic of adults, resulting of a disorder on inadequate mineralization of newly formed bone matrix. The term osteomalacia means "soft bones". The osteomalacia has an osteopenic pattern with fractures or pseudofractures. Several diseases can result in osteomalacia, almost always related to disorder on vitamin D metabolism.
4) Osteopetrosis: a group of at least nine developmental disorder, rare and congenital, that characterize a disease induced by an autosomal developmental disorder, also known as stone bone or marble bone disease, which shows its intense radiopaque aspect. The bone texture is very hard as a stone also involving cartilagenous areas. The bone is easily fractured. There is almost no marrow and it is described the splenomegaly and hepatomegaly with increased lymph nodes to compensate the lack of hematopoiesis, besides severe anemia. It end up occurring compression of nerves in the foramen and promoting facial palsy.
5) Sclerosis or bone condensation: state with imaging appearance of increase on thickness and number of bone trabeculae, reducing the size and appearance of medullary spaces on radiographs and tomographies.

Final considerations

The acquaintance of bone biopathology has fundamental importance, since the teeth are inserted in bone, naturally or orthodontically move by the bone, as well as maxillae frequently receive and adapt to bone integrated implants. On rehab, orthodontic and pre surgical plannings, the prior diagnosis of the bone state implies in recognizing the lesions and pathological situations that involve in clinical practice. The success of odontologic treatments, especially its stability, is closely associated to structural and functional balance of maxillary bones. The standardization of nomenclature and concepts facilitate the communication and the stablishment of uniformed protocols and conducts.

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Surgical elevation of maxillary sinus mucosa: Is it necessary to use biomaterials?

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SINUS FLOOR ELEVATION SURGERY

The bone resorption that occurs after extraction of maxillary posterior teeth may result in severe vertical and/or horizontal bone loss, compromising the planning of rehab with implants in that region. Numerous grafting techniques have been described and used aiming to restore adequate bone volume for posterior implants installation. The most used technique to restore the anatomy of this region is the procedure of maxillary sinus floor augmentation. The maxillary sinus elevation surgery was initially described by Tatum,[1] in 1986, being also reported by Boyne and James,[2] and Wood and Moore.[3] In this procedure the access to maxillary sinus is obtained through making a bone window on the lateral sinus wall, using a spherical diamond drill number 6-8, maintaining the sinus membrane integrity. The sinus membrane is then carefully lifted with the aid of specific curettes. This mobilization is performed with the bone window adhered to the membrane and displaced to the maxillary sinus roof. Created the desired space, the material chosen for grafting is then inserted.[4] In 1994, Summer[5] described an alternative surgical technique to increase the bone volume in the posterior maxilla on which the access to the maxillary sinus floor was performed through the alveolar bone crest using osteotomies of varied diameters aiming to surgically make an alveolus. The sinus mucosa was lifted and a grafting material was inserted, preceding the concomitant installation of a titanium implant. The referred technique has as main recommendation the necessity of gain of height on the maxillary sinus floor of at most 2 to 3mm. It is considered a less invasive alternative, especially for regions that did not need great sinus mucosa lifting.

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BIOMATERIALS USED

Numerous grafting materials for filling the space created after sinus mucosa lifting have been described in literature. Among them, it can be mentioned the autogenous bone,[6] allogeneic bone,[7] deproteinized bovine bone,[8] tricalcium phosphate/hydroxyapatite,[9] tricalcium phosphate ceramic,[10] Bioglass,[11] platelet rich plasma,[12] BMP-2,[13] a concentrate of autogenous bone marrow cells,[14] resorbable gelatin sponge[15] and nanocrystalline hydroxyapatite.[16] The results of the studies that used different grafting materials in this technique are similar regarding bone formation and implants survival on medium and long term. The success percentage of implants installed in grafted areas are close to the obtained with the use of autogenous bone.[17]

OSTEOGENIC POTENTIAL OF MAXILLARY SINUS MUCOSA

The similar results obtained with the use of different materials prove the predictability and success of the technique, regardless the biomaterial chosen for grafting. Such findings suggest the important role of sinus membrane on bone formation. Some studies have proved, through *in vitro* and *in vivo* models, the potential for bone formation of cells that compose the Schneider's membrane. Gruber et al[18] evaluated such properties in experimental study that gathered sinus membrane samples from adult swines. Initially, the cells were cultured and the STRO-1 expression (important enzyme expressed by osteoblastic lineage cells and adult osteoblast) was identified. Besides, cells were incubated in environment with BMP-6 and BMP-7, aiming to determine the osteoinduction potential previously proved, through alkaline phosphatase activity, osteocalcin and mineralization of extracellular matrix. After analysis of results, it was concluded that the maxillary sinus mucosa has mesenchymal progenitor cells and/or of osteogenic lineage. These findings could also be evidenced by Srouji et al[19] which in study about culture of human cells from Schneider's membrane, found its osteogenic potential which, according to the authors, contributes positively to the success on the application of maxillary sinus floor augmentation techniques. On the following year, the same group of authors evaluated the osteogenic potential of sinus membrane in experimental *in vivo* model of tissue ectopic transplantation. The samples of cells were obtained in orthognatic surgery procedures in five patients. After collection, the membrane cells were extracted, isolated and cultured in osteogenic environment which reveled presence of osteoblasts by the high alkaline phosphatase activity. Another fraction of the sample was subcutaneously implanted in immunodeficient rats for 8 weeks. Formation of new bone could be observed on sites, proving the congenital osteogenic potential of the Schneider's membrane. It is also emphasized its important role on bone repair after procedures of maxillary sinus floor augmentation.[20]

SINUS MEMBRANE LIFTING TECHNIQUE WITHOUT THE USE OF BIOMATERIAL

Lundgren et al[21] were the pioneers on the description of sinus membrane lifting technique without the use of material. In this work the authors reported a case of previous procedure of enucleation of cystic lesion in the maxillary sinus of patient referred to maxillary sinus floor augmentation. The lesion was removed and the rupture on sinus mucosa was sutured with simple stitches in resorbable wire; and the removed bone window was replaced. After three months of repair, the space between the replaced bone window and the sutured sinus mucosa was totally filled with formation of new bone. The surgical technique was, therefore, repeated in a second patient, with similar findings. After the first report, other works in animals and patients from this same group have already been published.

Steps used on technique performance:[4]

1) Making of bone window by oblique osteotomy with micro reciprocating saw.
2) Careful dissection of osteotomized bone window and sinus mucosa.
3) Storage of bone window in sterile saline solution.
4) Careful detachment of sinus mucosa.
5) Milling and installation of bone integrable implants.
6) When the immediate installation of implants is not possible because of the remnant alveolar bone crest size, the membrane is kept suspended by suture or a space maintenance device.
7) Repositioning of bone window and adhesive fixation with n-Butyl cyanoacrylate.
8) Suture.

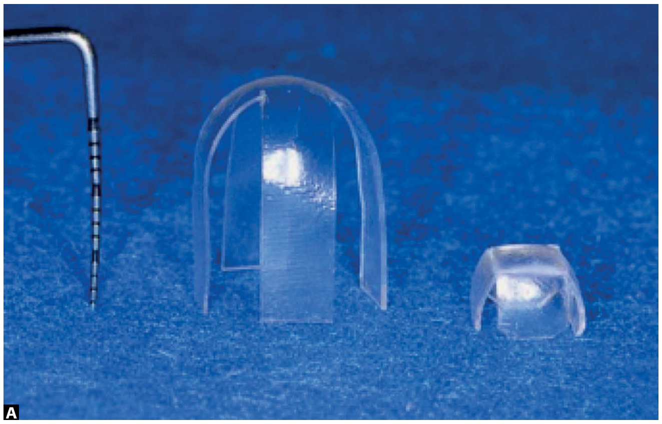
On the technique indication, it is important an alveolar bone remnant of at least 3 to 4 mm, for posterior milling and good locking of implants.

SPACE MAINTENANCE DEVICE

Aiming to apply the principle of space maintenance after sinus mucosa elevation, some studies have tested the use of devices to perform such role (Fig 1), especially in cases in which the installation of implants cannot be performed right after the lifting procedure. Up until now, it has not yet been developed an ideal space maintenance device. Cricchio et al[22] in study in primates evaluated the hypothesis described using a synthetic resorbable appliance (polyglactin 910) of 6 x 6mm. Eight animals were submitted to bilateral maxillary sinus elevation surgery. On one side, the resorbable appliance was installed with bone integrable implants. On the opposite side it was performed only the installation of the appliance, without implants. After six months, four animals were sacrificed while the others were submitted to installation of implants on the sinuses that received only the devices. It was concluded that the use of devices on the present experimental model was not successful, results assigned to lack of stability on the implanted site. Later, in 2011, the same group of authors tested synthetic resorbable appliances with new conformation, in similar experimental model. In this study, both maxillary sinuses were lifted and a device was inserted in each side, however without insertion of bone integrable implants. Six months later, the primates were sacrificed and it was found that most of the devices were displaced, which damaged the bone formation process, once the sinus membrane was not kept in position after lifted up.[23] Schweikert et al[24] evaluated the effect of titanium mini plate fixed with screw on the upper margin of the open bone window, keeping the osteotomized bone fragment of the window positioned to the interior of the maxillary sinus of primates. On the same surgical act, bone integrable implants were installed and after 3 and 6 months the animals were sacrificed. It was concluded that despite the new formed bone have been visualized under the device, volume reduction on formed bone tissue was observed in both experimental periods. It is also emphasized the need of new studies for development of a device with adequate characteristics (Fig 1).

RESULTS OF EXPERIMENTAL AND CLINICAL STUDIES

Experimental and clinical studies have been published in literature with the application of this technique. Palma et al[25] performed an experimental study comparing the histological results of sinus membrane lifting with simultaneous installation of implants with and without the use of autogenous graft in primates. The procedures of maxillary sinus lifting were bilaterally performed where one side was treated with mucosa lifting + implants + autogenous bone graft; and the other side only mucosa lifting and concomitant installation of implants. After data analysis, it can be concluded that the amounts of obtained increase on bone tissue with or without autogenous bone were similar after



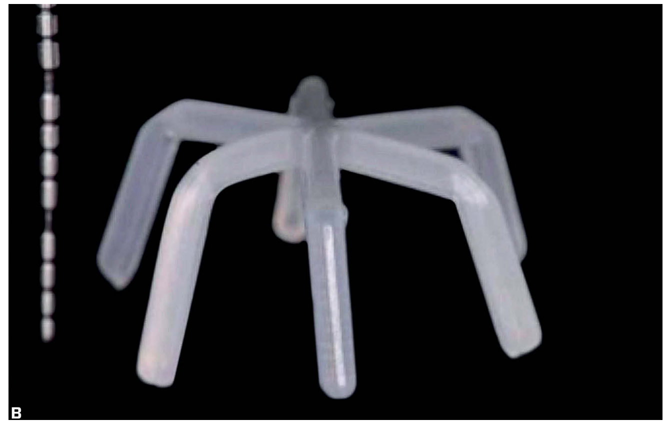


Figure 1 - Synthetic resorbable appliances (polyglactin 910) for space maintenance after maxillary sinus mucosa elevation without implant: **A**) non-permeable appliance; **B**) appliance that favors the contact between coagulum and sinus membrane.

6 months. Lundgren et al[4] presented preliminary results of the technique performance in 10 patients. A total of 19 implants were installed and the formation of new bone was observed in all patients, being stable after 12 months of prosthetic load. These results were also found in the study by Hatano et al[26] and Thor et al.[27] In both clinical studies, the formation of new bone was radiographically proved, with all installed implants successful. Recently Borges et al[28] applied the technique in 15 patients in need of bilateral maxillary sinus floor lifting procedure. In a prospective, controlled, randomized and split-mouth study, it was compared a side treated with sinus mucosa lifting, autogenous bone and bone integrable implants, to another with only implants and mucosa lifting, without grafting (Fig 2, 3, 4). It was concluded that both techniques presented similar occurrence of complications. The formation of new bone was observed in the same way on the two types of treatment.

CONCLUSIONS

1) Evidences of experimental and clinical studies prove efficient bone formation in maxillary sinus lifting procedures without the use of grafting materials.
2) The most efficient application of this technique is when the alveolar crest remnant bone has minimum size for installation of implants concomitantly to membrane lifting.
3) It is necessary more studies with large case series and evaluation of success and survival rates of implants installed on long term, also new experimental models of development of space maintenance devices.
4) In 2012, nearly 355 patients were operated by maxillary sinus floor lifting technique without the use of biomaterial (200 patients in Italy, 120 in Sweden and 35 in Brazil).

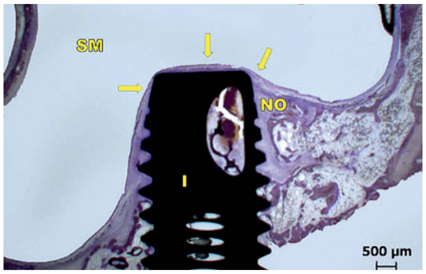


Figure 2 - Histological section of implant (I) installed on maxillary sinus floor (SM) of primate, on a period of 10 days. View of maxillary sinus and implant supporting sinus membrane (arrows). New bone formation process (NO) from Schneider's membrane. Staining: toluidine blue/pyronin Y. Magnification: 2,5x.

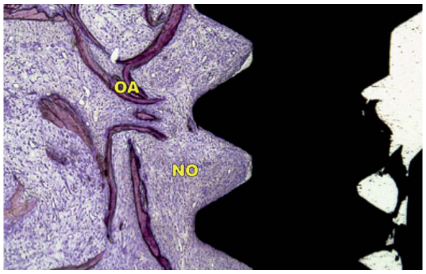


Figure 3 - Histological section of implant installed on maxillary sinus floor of primate on a period of 10 days. In this case, the maxillary sinus was grafted with autogenous bone (OA). It is noticed the formation of new bone (NO) around the implant. Staining: toluidine blue/pyronin y. Magnification: 6x.

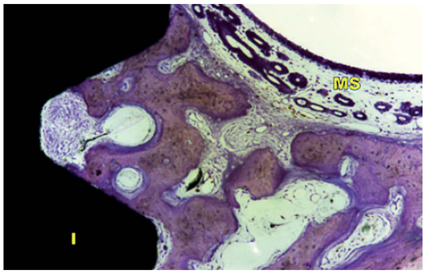


Figure 4 - Histological section of implant installed on maxillary sinus floor of primate on a period of 45 days. It is noticed that the bone formation process begins from the membrane (MS) towards the implant (I). Staining: toluidine blue/pyronin y. Magnification: 10x.

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Assessment of bone/implant interface through SEM

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Fabrício Poletto **MASSOTTI****
Fernando Vacilotto **GOMES****

Images taken with the Scanning Electron Microscope (SEM) of the interface between bone and Nanotite™ implant (Biomet 3i®), with twenty-one days of osseointegration.

It is observed the intimate contact of bone with titanium nano-textured surface, as well as calcification of the collagen matrix and bone extensions created toward the surface of the implant.

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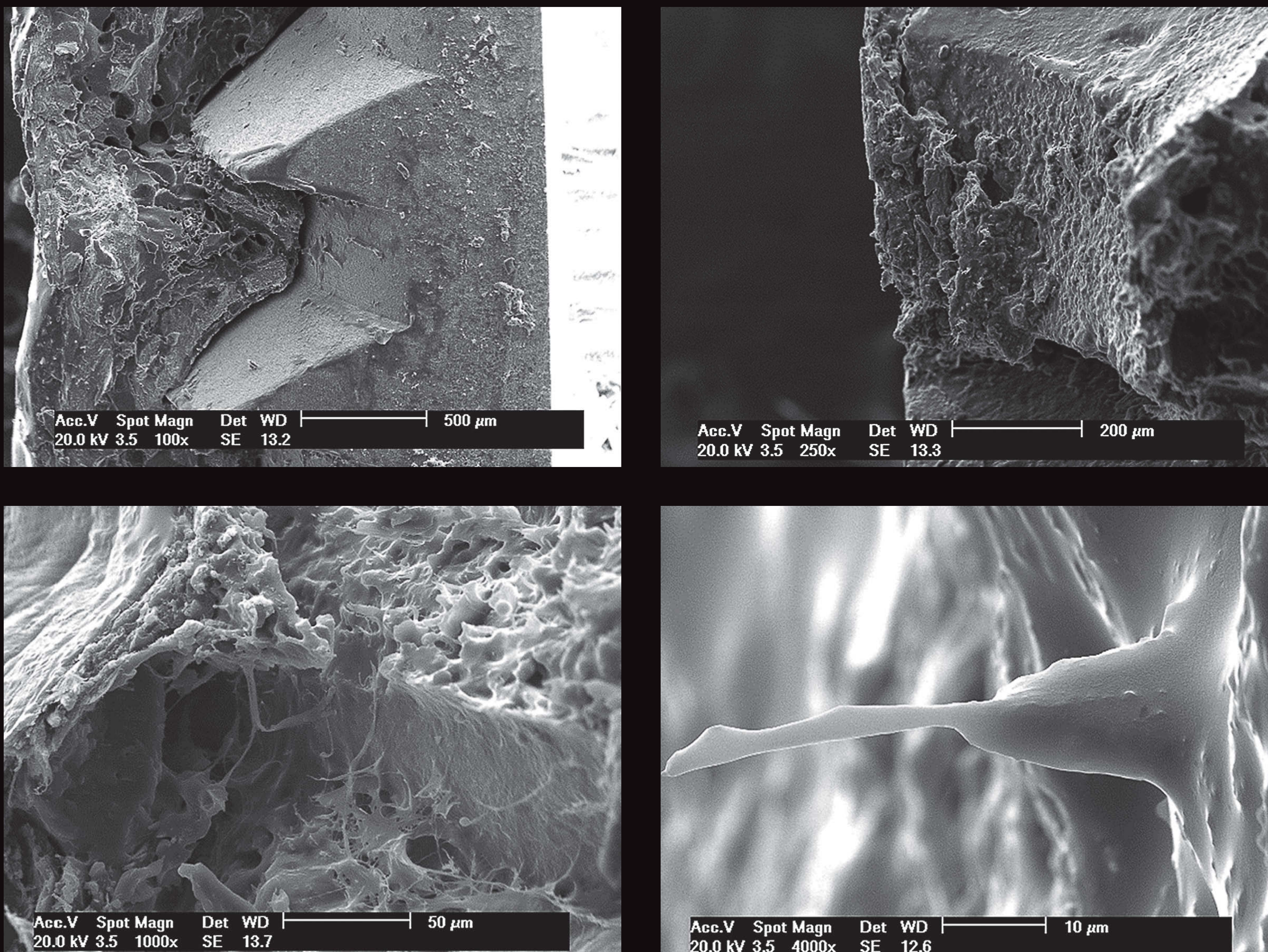
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Periodontal treatment in patients with diabetes mellitus type 1 and type 2: Case report

Reila Tainá **MENDES***
Fábio Anibal **GOIRIS****

Abstract

Introduction: It is unquestionable the influence of diabetes mellitus (DM) on the pathogenesis of periodontal disease. Both conditions have got a bidirectional relation on the inflammatory response. Patients with diabetes mellitus and without a proper metabolic control show a worse status of the periodontal disease and also more difficult in the glicemic control of DM. Types 1 and 2 of DM have their particularities and clinical differences related to the metabolic control or to the periodontal therapy. **Objective:** This paper reports two cases of patients with diabetes mellitus and periodontal disease, being one of DM type 1 and the other of DM type 2. **Conclusion:** The post-operatory result showed resolution of the periodontal inflammation in both cases. After therapy, there were no periodontal pockets nor suppuration or bleeding on probing. However, the clinical management of both forms of DM was individualized. The use of systemic antibiotics associated to periodontal therapy was necessary only for the patient with type 1 DM.

Keywords: Diabetes mellitus. Periodontitis. Therapeutics.

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Introduction

Periodontal disease and diabetes mellitus have a close relationship related to the inflammatory response.[1] Microbial biofilm is the main etiologic factor of periodontal disease[2] and, although responsible for the beginning of process, the bacteria present in this biofilm and witch colonize the subgingival area are unable to cause the disease by themselves. It is essential the existence of a susceptible host.[3,4] Therefore, there are biologic conditions witch interfere on the disease progress: The *risk factors*.[5,6] Nowadays, two risk factors are accepted and proven by epidemiological and longitudinal studies: The smoking and the diabetes mellitus.[6]

Diabetes mellitus (DM) is the most common human endocrine disorder[7] and represents a heterogeneous group of clinical and genetics alterations due to abnormal level of blood glucose[8] and disorders on the lipids and carbohydrates metabolism.[9] Chronic hyperglycemia, its main characteristic, its due to the lack of insulin secretion by pancreas β cells, by the muscle and the liver's resistance to the insulin action, or these both situation contributes in the same way to the pathologic state. It results into damage in different organs: Heart, eyes, livers, nerves and vascular system.[8] The most common symptoms of DM are: Polyuria, polydipsia and polyphagia; and the classical signs of the disease are retinopathy, nephropathy, neuropathy, macrovascular disease and changes in tissue healing. Therefore, diabetes mellitus have a huge impact over the whole body tissues, including the mouth. Evidence shows that DM, especially when non treated, increases the prevalence and incidence of gingivitis and periodontitis, being an important and independent risk factor to periodontal disease.[10]

An observational study pointed out the prevalence of gingivitis and periodontitis among a diabetic population being of 55% and 35,3,% respectively. This data denotes the oral care as an important factor not only for an improvement to the oral health but as a factor that contributes to the glycemic control in diabetic patients.[11] Type 1 DM is diagnosed in children and young adults and its due to an autoimmune destruction of pancreas β cells in the Langerhans islet, leading to a considerable reduction on the insulin production.[9,10] Type 1 DM is generally associated to more severe forms of periodontitis. On the other side, type 2 DM affects adults on the forth decade of life, and its main characteristic is an increase on the insulin resistance, which leads to chronic hyperglycemia.[10]

This work presents two cases of patients with periodontal disease, being one with T1DM and the other with T2DM. It was approached the most important characteristics and clinical, therapeutical and pharmacological differences between both forms.

Case report 1

Female, seventeen-year-old patient, was diagnosed with type 1 DM at 9 years of age. The treatment applied for this disease was systemic administration of insulin. Severe periodontal defects were present, including spontaneous gingival bleeding with exudates and periodontal pockets with 7 millimeters of depth. By the initial clinical examination, the patient presented Visible Plaque Index of 100%, being 3 the score for the Gingival Index in 60% of the teeth (upper and lower), with gingival pain. Inflammatory gingival hyperplasia and pathological tooth mobility was one notable characteristic, especially on the maxillary anterior teeth (Fig 1 A and B). Trauma from occlusion was also present at this region and turned the teeth into another position. Radiographies show huge bone loss, especially on the maxillary and mandibular anterior teeth (Figs 2 A and B). The patient was diagnosed as being affected by aggressive localized periodontal disease.[12] The first part of the treatment was scaling and root planning

Figure 1 - Images showing clinical aspect of type 1 diabetes patient. **A, B)** Initial aspect. It can be observed gingival hyperplasia, pathological dental migration and spontaneous bleeding. Also one can notice the presence of microabscesses in the region of teeth 13, 32 and 42. **C)** Realization of periodontal surgery with modified Widman flap. **D)** Clinical aspect one year after conclusion of periodontal therapy of the patient.

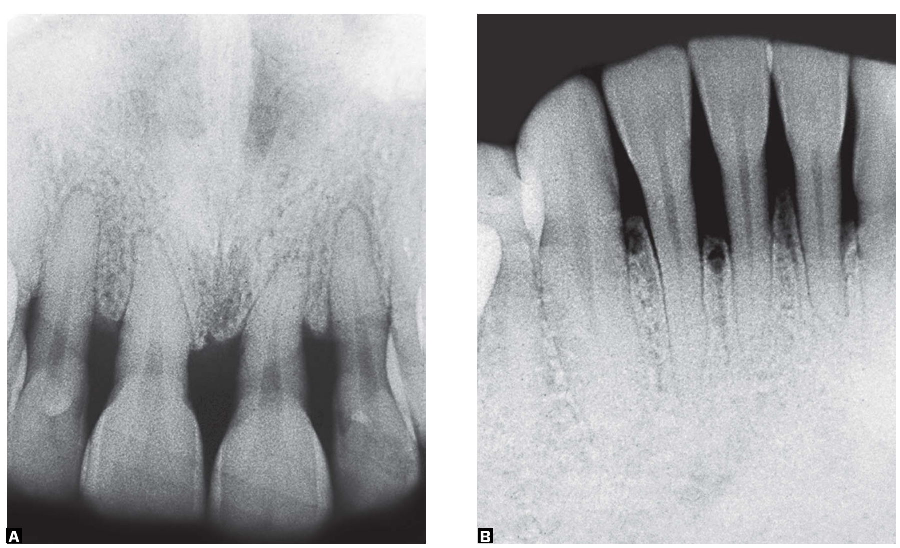

Figure 2 - **A, B)** Initial radiographic aspects of type 1 diabetes patient. It can be observed periodontal destruction with apical migration of alveolar bone crests.

Figure 3 - Clinical aspect of patient with type 1 DM five years after periodontal therapy.

and oral hygiene education. Occlusal adjustment was performed by selective grinding. Additionally to the mechanical therapy, Amoxicillin 500 mg and metronidazole 400 mg were administered for 10 days.[13] The patient realized mouth rinses with chlorhexidine 0.12% twice daily. Thirty days after the treatment, the inflammatory state was reduced; reduction on the probing depth and clinical attachment gain were observed, as well as reduction on the teeth mobility. Nevertheless, the mandibular anterior teeth still showed deep periodontal pockets, being necessary a surgical approach to treat them. It was also performed modified Widman flap surgery (Fig 1C). Proservation and reevaluation of treatment were performed after 2, 4, 6 and 12 months aiming to observe the stability of the treatment and evaluate the necessity or not of a new intervention. One year after the initial therapy, there was no inflammation and the teeth naturally migrate to them proper position (Fig 1D). The Gingival Index and the Visible Plaque Index were approximately 15%, which denotes the efficacy of the orientation related to the oral care. After five years (Fig 3), it was observed stability of the treatment.

Case report 2

Male, forty-three-year-old patient, presented T2DM. The disease was controlled only with alimentary diet. The patient also presented periodontal defects, which included gingival bleeding, deep periodontal pockets (about 6 mm) especially on the maxillary incisors. Visible Plaque Index was 70% and the Gingival Index was 2, with bleeding on probing. The patient did not present teeth mobility nor gingival hyperplasia (Fig 4A and 5). Trauma from occlusion was not present. The patient was diagnosed as affected by a generalized chronic periodontal disease.[12] The initial treatment was performed by scaling and root planning, followed by oral hygiene instruction. The patient realized mouth rinses with chlorhexidine 0.12% twice daily. Systemic antibiotics were not necessary. After 30 days of this treatment, the inflammation was completely reversed. Visible Plaque Index and Gingival Index were reduced, surrounding 15%. This reduction was due to the reinforcement of the oral hygiene orientation and biofilm control. Just like in the previously described first case, proservation and reevaluation were performed after 2, 4, 6 and 12 months. One year after the treatment, periodontal pockets or bleeding on probing were absent (Fig 4B).

It is noteworthy that both patients received a proper glycemic control and received medical care related to de diabetes mellitus control. They also signed an informed consent allowing their information to be published.

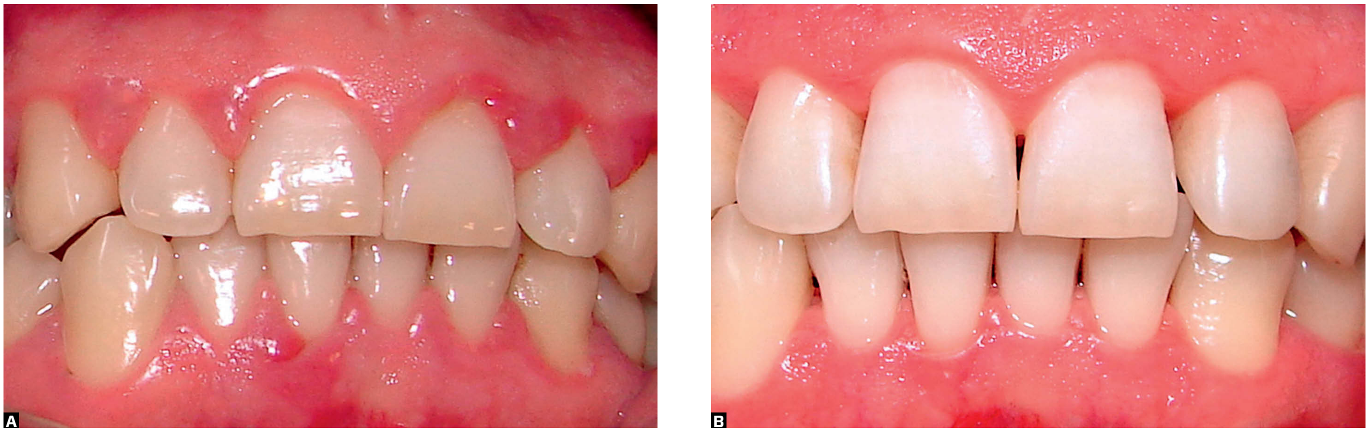

Figure 4 - **A**) Clinical aspect of type 2 diabetes patient. It can be observed hyperplasia in the papillae region. **B**) Clinical aspect one year after periodontal therapy conclusion of the patient..

Figure 5 - Initial radiographic aspect of type 2 DM patient. It can be observed mild horizontal bone loss.

Discussion

The most important systemic alterations due to diabetes mellitus are the hyperinflammatory tissue conditions and alterations on the collagen structure. There is an association between the immune response alteration and the presence of *Advanced glication-end products* (Age) in the bloodstream. This products are connected to specific receptors present on the monocyte membrane named RAGE (ligation Rage/Age) resulting in an increased production of pro-inflammatory cytokines such as Interleukin 1 (IL-1), Interleukin 6 (IL-6) and Tumor Necrosis Factor Alpha (TNF-α).[14] The patient with diabetes also presents an exaggerate response of the innate immunity, with dysfunction of the polymorphonuclear lymphocytes, which leads to a reduction on the host defense system and allow the presence of bacteria inside the tissues.[15] Related to the periodontal tissues, the hyperglycemia is characterized by an increased in IL-1β, IL-6, IL-8, TNF-α, PGE_2, as well as a reduction on the collagen production followed by its lack on the osteoblasts production. There is an imbalance between osteoblasts and osteoclasts, with predominance of this last one, which leads to a reduction on the bone formation and increases the resorption of the mineralized tissues.[16]

In a comparative study between the DM types 1 and 2 related to the severity of periodontitis, type 1 DM was associated to a higher loss of tissue and the patients affected were mainly young. Moreover, in the patients diagnosed with type 1 DM, there was a higher concentration of IL-1β and TNF-α on the crevicular fluid. Therefore, theoretically the patients with type 1 DM may be classified as having an aggressive form of periodontal disease.[7] This situation that was observed in the present work. The T1DM patient showed a more severe form of periodontal disease and higher tissue destruction when compared with the patient of the second case. The first patient was also classified as affected by an aggressive form of periodontal disease, whereas the patient with type 2 DM was classified as affected by a chronic form of periodontal disease.

Moreover, in both cases previously described there is an important difference between the types 1 and 2 of DM. The first one presented an exacerbated state of periodontal inflammation, with the presence of micro abscesses, tooth mobility and spontaneous bleeding. In the patient with T2DM, the periodontal inflammation showed an acquiescence bias.

Other pathogenic characteristics of DM types 1 or 2 are a lack on the collagen synthesis by the fibroblasts affected and an increase on the production of metalloproteinases such as collagenase, which contributes to the loss of periodontal insertion.[16] Therefore, chronic hyperglycemia creates an environment compared to an acute inflammation, with an increase on the vascular permeability and an increase on the leukocyte adhesion on the endothelial tissue.[1] The patients with T1DM also presented a more severe status of the periodontal disease due to a higher concentration of IL-1β e TNF-α in the crevicular fluid when compared to the patients with T2DM[7], which was observed on the presented cases.

Lappin et al[17] showed that patients with T1DM had defects on the bone formation, which impair the host response to the periodontal treatment. Low levels of osteocalcin (a biomarker of bone formation) in patients with T1DM is a suggestion that these patients have got a reduction on the bone repair, which turns them to be more susceptible to the progress of periodontal disease. This situation may contribute to the severity of the periodontal inflammation showed in the first case presented. Besides that, RANKL — a TNF receptor protein — is an important factor for differentiation, growing and activation of osteoclasts, and is also related to bone resorption. High levels of RANKL are associated to bone resorption on periodontitis. The levels of RANKL are dependent of OPG (osteoprogenin) expression, a natural inhibitor of RANKL. Image analysis showed high levels of RANKL in inflamed periodontal tissues in patients with T1DM and low levels of OPG. This condition leads to bone resorption and loss of clinical attachment especially in patients with diabetes mellitus. The two systems which modulate bone resorption, RANKL and OPG, present specific relationships: RANKL protein is associated to lymphocytes and macrophages whereas OPG is related to endothelial cells. The higher is the level of RANKL, more severe is periodontitis. Periodontal therapy has an important factor in reducing RANKL expression in the inflamed periodontal tissues. Not only periodontal therapy when associated to local injection of OPG does reduce RANKL expression in alveolar bone affected by periodontitis, but it increases OPG expression as well.[17]

The bases of periodontal therapy are the same for patients with diabetes or not.[18] These bases are also applied in the same way for patients with T1DM or type 2; and the clinical result of the therapy shows resolution of the periodontal inflammation, reduction on the probing depth and clinical attachment gain. However, the gingival hyper-inflammatory state, especially in patients with T1DM, requires a clinical management which includes a systemic care related to the glycemic control. This control is determinant on the periodontal disease progress and on the level of pro-inflammatory cytokines present on the crevicular fluid. Researches show that periodontal therapy may reduce hyperglycemia present in patients with DM.[8] In both cases presented above, the patients received medical care associated to periodontal treatment, since both pathologies have a bidirectional relationship. Therefore, related to the severity of periodontal disease, a surgical complementation of the basic periodontal therapy may be necessary sometimes, just as it was performed on the first case.

Evidence shows that mechanical debridement not always is enough to treat the disease when facing a more severe periodontal destruction, which imply the use of systemic antibiotics just as it was done in the case 1 (patient with T1DM). A proper evaluation of the periodontal infection state, such as the detection of the presence of recurrent acute inflammation and micro abscesses formation in diabetic patients is essential to plan a proper treatment management. Moreover, it was shown that periodontal therapy associated to doxycycline was related to better results in the treatment of patients with T1DM[19]

In a clinical trial which involved non surgical periodontal therapy in patients with T2DM, it was shown a reduction in the level of reactive C protein after three months of periodontal treatment, such as reduction on the bloodstream level of IL-4, IL-6, IL-8 e IL-10. These findings show that periodontal therapy may reduce systemic inflammation (with a decrease on some circulating inflammatory cytokines levels), which is relevant to the diabetic patient,[20] since such factors are related to periodontal destruction.[16] The periodontal statement of non controlled diabetic patients is worse than those who perform a proper glycemic control.[21] In both presented cases the patients realized a glycemic control adjunct to periodontal therapy.

Evidence shows that the treatment of chronic periodontal infection is important for the patient with diabetes and sometimes periodontal surgery may be necessary.[22] Even dental implants with satisfactory osseointegration may be obtained in patients with DM types 1 or 2, once the patient have a proper glycemic control. However, the implants are not indicated to those patients who do not control the glycemic level because of its negative effect related to osseointegration and accumulation of AGEs on the blood and on soft and hard tissues of the peri-implantar region.[16]

Auyeung et al[24] examined 100 diabetic patients, of which 72 showed severe periodontal disease and besides that, it was not found patients with DM who present a healthy periodontal status. The authors also showed that non surgical periodontal therapy resulted in benefits to the patients with T2DM, not only in mild periodontitis, but in its severe form as well. The second case previously presented did not required a surgical approach. Moreover, the periodontal statement had huge relevance related to the metabolic condition of the patients with T2DM, including reduction of the hyperglycemia after the periodontal therapy.[23]

Aspirello et al[7] pointed that the patients with T1DM generally need a different approach, since type 1 shows more severe periodontal complications, such as a higher duration of the disease, being also related to the aggressive form of periodontitis. This situation also agree with the cases shown in this work. Llambés et al[24] pointed that the systemic use of antibiotics added to periodontal therapy in the treatment of patients with types 1 or 2 of DM were successfully reported in literature with better results than periodontal therapy by itself. In the first case, periodontal therapy was associated to administration of amoxicillin and metronidazole,[13] which showed satisfactory results.

Facing the particularities related to each type of diabetes mellitus, being the patients with type 1 related to a more severe form of periodontal disease, the treatment to be applied may be individualized to each patient. It may be suggested that more frequently the patients with type 1 DM may obtain a better result when the periodontal therapy is associated to the use of antibiotics. Moreover, it is important to reinforce that the periodontal therapy should be performed in conjunction with the patient glycemic control, no matter the patient is affected by type 1 or type 2 of DM; it leads to a better statement of the mouth or the general health of the patient.

Conclusion

1) Efforts may be done in order to prevent periodontal disease in patients with diabetes mellitus, especially those who have already presented some form of periodontitis since these patients are more susceptible to a more severe form of the disease.
2) The initial periodontal therapy is the same for patients with DM or not, so it is the treatment of patients with type 1 or type 2 of the disease. However, T1DM owes more attention related to medical and to the periodontal care because of its more aggressive form of the disease.
3) The clinical periodontal statement is generally more severe in patients with diabetes type 1 when compared to patients with type 2, which sometimes requires a different clinical approach, such as a surgical procedure or the use of antibiotics. Both cases presented showed satisfactory results despite the type of diabetes or the performed therapy.
4) The presence of diabetes by itself is not an impediment to periodontal treatment surgical or not. The determining factor to the therapy's success is the trilogy glycemic control, medical care and dental treatment.

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Assessment of life quality of a patient with ectodermal dysplasia rehabilitated with osseointegrated implants: Five years clinical and radiographic follow-up

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Carlos Eduardo **FRANCISCHONE*****
Bruno Sotto **MAIOR*****

Abstract

Ectodermal dysplasia is a genetic disorder associated with dental anomalies that severely affect function, aesthetics and quality of life. Patients with ectodermal dysplasia often have complete or partial anodontia, which affects normal jaw development. Dental implants have increasingly been used for the rehabilitation of these patients because their disease severity reduces treatment options. This report describes the pre- and postoperative quality of life of a 55-year old woman with ectodermal dysplasia that presented with hypodontia and severe atrophy of the jaws. She was treated with dental implants for immediate functional loading using the Novum® protocol for the mandible and the All-on-4® hybrid technique in the maxilla, together with zygomatic implants and 3 conventional implants. The patient was followed up for 5 years.

Keywords: Ectodermal dysplasia. Zygomatic fixtures. Quality of life.

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Introduction

Ectodermal dysplasia (ED) describes a group of inherited diseases characterized by the defective development of tissues of ectodermal origin during embryogenesis. More than 170 different clinical conditions are currently known. They impair the development of ectodermal structures, such as hair, skin, nails, sweat glands and teeth.[1-5]

Changes in oral epithelium may present as the congenital absence of deciduous and permanent dentition and hypoplasia of the alveolar bone. In ectodermal dysplasia, the highest incidence of hypodontia is found in the mandible. When teeth are present, they may have abnormalities, the most frequent of which are conoid teeth and taurodontism.[1,4,8]

Congenital hypodontia in ectodermal dysplasia is responsible for the poor development of the alveolar bone, which results in mandibular and maxillary hypoplasia, occlusal collapse and narrowing of the alveolar ridge.[1,3,9]

Hypodontia may affect the development of the mandibular angle and the transversal and sagittal growth of the maxilla and the mandible. Moreover, vertical growth may be affected by the reduced alveolar height.[3,9] Growth abnormalities may lead to an occlusal collapse, which is responsible for a reduction of the height of the lower third of the face and retrognathism.[1] Together with hypodontia, the craniofacial abnormalities resulting from ectodermal dysplasia reduce masticatory capacity and lead to esthetic changes that may affect socioeconomic activities and quality of life. Therefore, patients with ectodermal dysplasia require prosthodontic rehabiliation.[1,2,4,10] However, the instability and poor retention of conventional complete dentures and removable partial dentures in patients with a narrow alveolar ridge and conoid teeth are frequent causes of patient dissatisfaction.[1,7,11,12] Therefore, implant-supported dentures have become an alternative for the oral rehabilitation of individuals with ectodermal dysplasia.

This report describes the clinical case of a patient with ectodermal dysplasia rehabilitated with conventional and immediate-loading fixed dentures supported by conventional and zygomatic implants and followed up clinically and radiographically for five years.

Case report

A white 55-year-old woman searched for a private dental clinic for prosthodontic rehabilitation due to a root fracture in tooth #33 and aesthetic and functional disorders resulting from the fact that she had never had any maxillary teeth. Oral examination revealed multiple hypodontia; she had only the right and left maxillary canines, both with crown malformations (conoid teeth). Those teeth were fragile due to endodontic treatments and the various metal ceramic crowns received during the patient's adult life, used as support for removable dentures retained with clasps. The signs of ectodermal dysplasia was more severe in her right side, with sparse hair, smaller right cheekbone (less volume in the area of the right zygomatic bone), no right eyebrow, no right breast, mild hypohidrosis and dry skin, but normal nails.

Clinical examination revealed that she had a maxillary complete denture and that only the canines, both conoid, were present in the mandible (Fig 1A). The maxillary and mandibular alveolar ridges were severely hypoplastic and atrophic (Fig 1B).

During the first visit, a VAS and the OHIP questionnaire were used to obtain information about her baseline psychological status and the functional conditions of her removable dentures.

Radiographs showed reduced height of the alveolar bone in the region of the mandibular canines; a left canine root fracture was also identified.

The treatment plan was divided into two phases. In the first phase, the height of the lower third of the face, as well as labial support, was recovered by replacing the old dentures with a full removable maxillary denture.[15] A CT scan of the lower arch was requested to evaluate and plan the surgery to extract the canines and immediately place the three osseointegrated implants using the Novum® Nobel Biocare approach and a multifunctional surgical guide, distributed according to the Roy polygon (Fig 2).[16,17]

Immediately after implant placement using torque greater than 40 N/cm^2, the interocclusal wax record was obtained between the multifunctional guide and the complete denture using an acrylic resin (GC Pattern Resins, Alsip, IL) (Fig 3). After waxing and bonding the guide to the cylinders, the set was used as an individual tray for the impression of the implant-cylinder-gingiva relationship by the addition of condensation silicone (Clonage, DFL, Rio de Janeiro, Brazil) and manufacture of the working model using the mandibular multifunctional guide.

A metal cast bar was manufactured over the working model obtained by means of immediate postoperative molding, and Premium Heraues Kulzer teeth (Hanau, Germany)

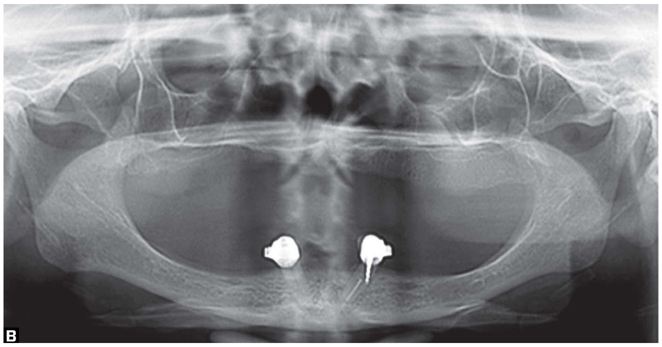

Figure 1 - Intraoral view at baseline; presence of mandibular canines; panoramic radiograph shows maxillary and mandibular atrophy.

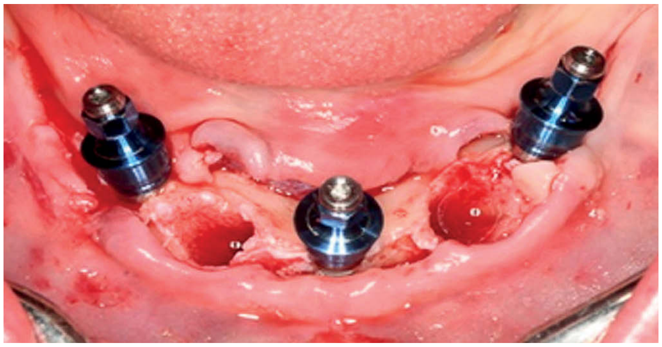

Figure 2 - Immediate postoperative appearance: 3 implants placed according to the Novum Branemark system.

Figure 3 - Intraoral view of the interarch impression using a multifunctional guide.

were mounted on that bar using the model obtained by duplicating the maxillary complete denture as a reference.

After the try-in of the waxed teeth over the metal bar and the evaluation of the bar adjustment to the implants and of the position and occlusion between arches, the acrylic resin was activated and the denture was loaded onto the implants using a 20 N/cm^2 torque for the prosthetic screw and occlusal adjustment, respecting the principles of mutually protected occlusion (Fig 4).[18,19]

After clinical and radiographic follow-up for 12 months, another CT scan of the maxilla was obtained and a model was produced to evaluate and plan the second phase of the treatment and the placement of four immediate-loading zygomatic implants (Fig 5). Study models of the edentulous maxilla and the implant-supported denture were manufactured using Jeltrate Plus alginate (Dentsply, Caulk, Milford, USA) and the models based on the patient's maxillary denture were mounted on a semi-adjustable articulator.

Implant placement was performed in a hospital due to the complexity of the procedure and the severe bone resorption of the patient's maxilla. A single 3.75 x 25 mm P.I. Brånemak implant was placed in the proximal region of the left canine pillar. However, in the right side, which was more severely affected, a 42 mm zygomatic implant

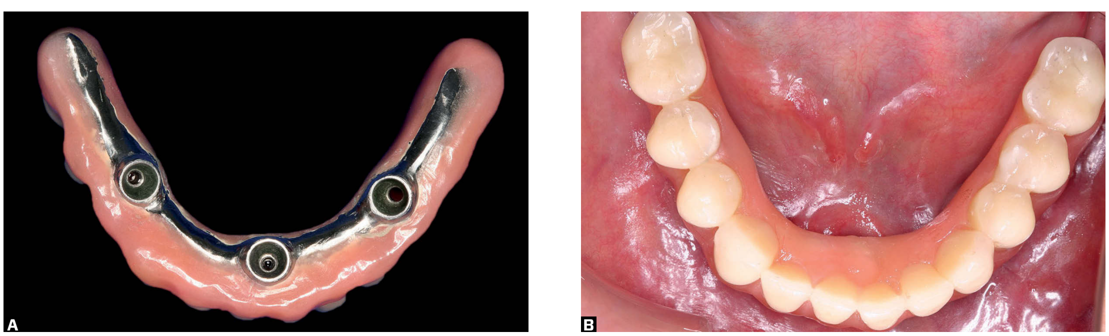

Figure 4 - Occlusal view of fixed mandibular denture 3 days postoperatively, and view of implant distribution and horizontal cantilever size.

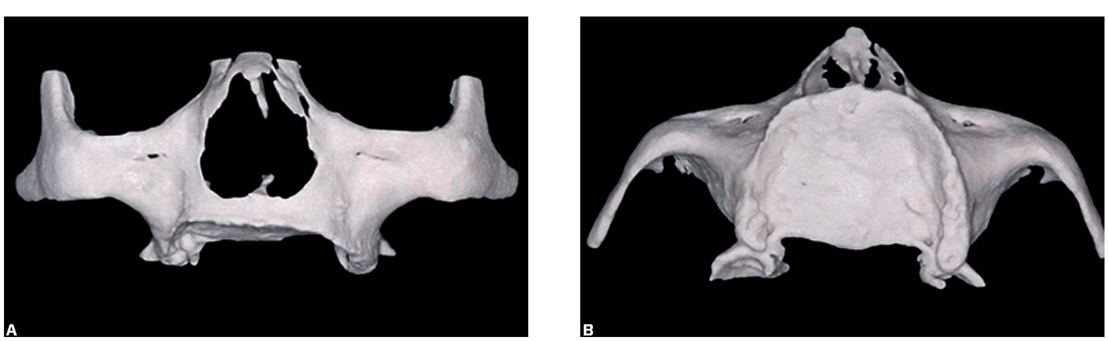

Figure 5 - 3D reconstruction of maxilla to demonstrate degree of atrophy and to plan and distribute zygomatic fixtures.

was placed, and two others, a right 40 mm and a left 42 mm implant, were positioned to emerge approximately in the region of the maxillary first molars.

Later, the patient was seen in the outpatient service and prosthetic rehabilitation of the mandible was performed using the same technique.

The metal bar united the four implants, and triple-compression acrylic resin teeth (Premium Heraues Kulzer, Hanau, Germany) were mounted on wax for an aesthetic try-in and to check bar adaptation.

After acrylic polymerization, the maxillary denture was attached with screws to the implants using a torque of 20 N/cm^2 and occlusal adjustment (Fig 6) according to the principles of mutually protected occlusion.[18,19]

One week after operation, panoramic and PA radiographs were obtained to evaluate implant position in relation to important craniofacial structures. The patient was seen for clinical and radiographic follow-up every six months for five years (Fig 7).

Evaluation of quality of life before and after fixed oral rehabilitation over osseointegrated implants

Quality of life was evaluated using the Oral Health Impact Profile (OHIP) questionnaire (Fig 8) and a visual analogue scale (VAS) (Fig 9). These instruments were used before

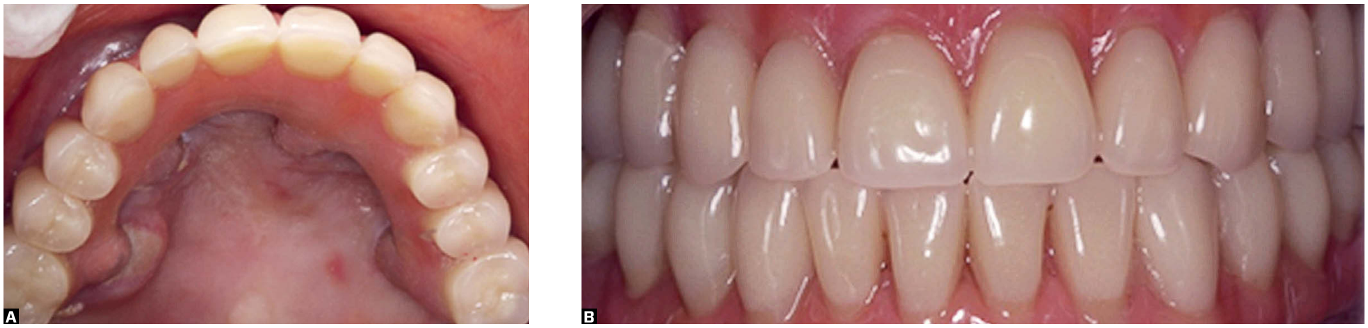

Figure 6 - Occlusal view of maxillary fixed denture 3 days postoperatively; final inter-arch relationship of maxillary and mandibular fixed dentures.

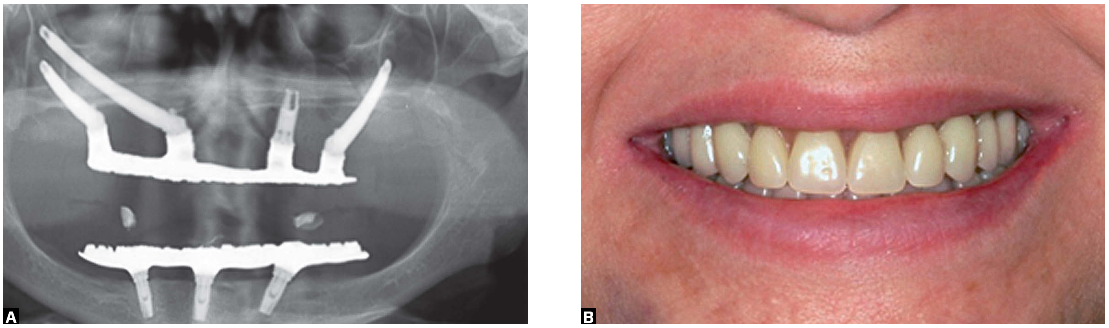

Figure 7 - Current clinical aspect and personal satisfaction with follow-up 5 years after fixed rehabilitation; control panoramic radiograph obtained every year after rehabilitation.

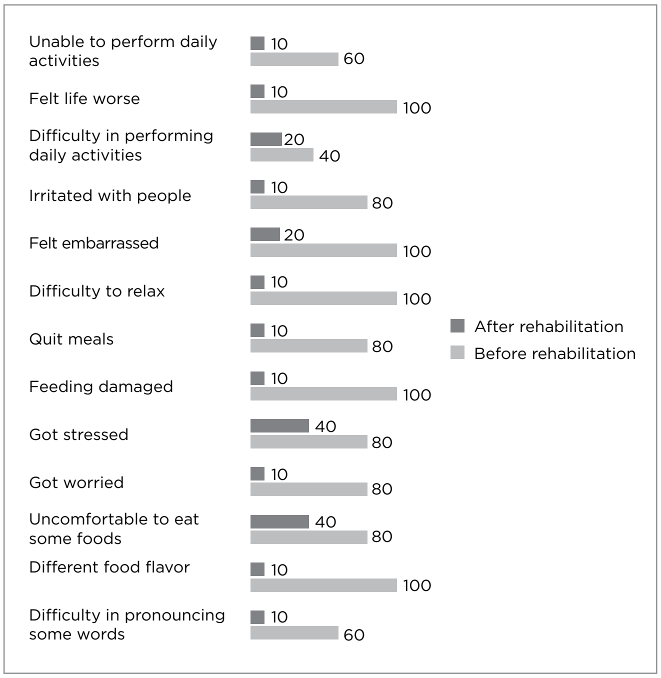

Figure 8 - Results of Oral Health Impact Profile (OHIP) questionnaire used to evaluate impact of fixed dentures on patient's quality of life.

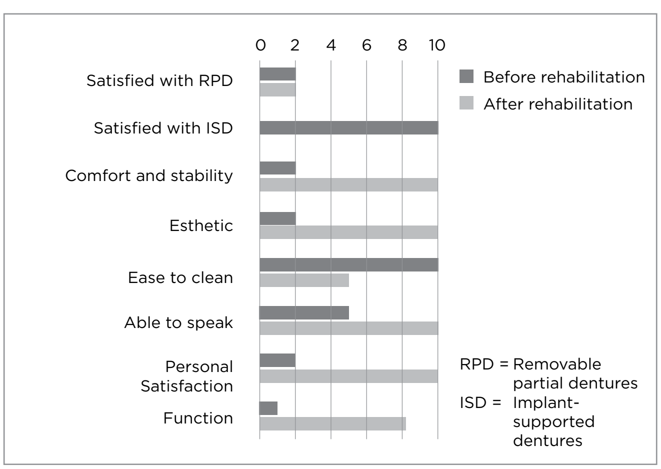

Figure 9 - Results of visual analog scale (VAS) used to evaluate impact of fixed dentures on patient's quality of life.

and 6 months after rehabilitation with immediate-loading osseointegrated implants to evaluate the patient's satisfaction with aesthetics, mastication and phonetics.

Discussion

Anodontia is a disabling functional and aesthetic condition for several people.[7] Craniofacial abnormalities due to ectodermal dysplasia are, for many individuals, devastating psychological problems, because a compromised appearance associated with congenital defects may inhibit normal social interactions and result in deficient psychosocial development.[1]

Some authors suggest that the treatment with implants should be delayed until skeletal growth is complete, and implant placement in growing patients is not recommended as a routine practice. Changes in implant position and height may result in complications, and factors such as growth variability between individuals and the difficulties in predicting the amount and direction of growth should be taken into consideration.[3,7,20]

In a clinical study of individuals with ectodermal dysplasia, Lamazza et al[3] did not find any changes in bone quality or bone healing, although a quantitative difference was found. However, radiographs taken at the time of definitive denture placement and 3 years later revealed that osseointegration was preserved, in agreement with the clinical results observed during the 5-year clinical and radiographic follow-up in our study.

Smith and Balshi,[1,12] also reported that, at the time of the second surgical phase, implant fixation in patients with ectodermal dysplasia was similar to that of implants in edentulous patients without ectodermal dysplasia. Therefore, the oral rehabilitation of patients with ectodermal dysplasia should benefit from the modern concepts of treatment with osseointegrated implants, as well as from the use of bone grafting techniques, tissue engineering and advanced prosthodontics.

Peñarrocha-Diago et al[21] described the oral rehabilitation of a patient with ectodermal dysplasia whose maxilla was severely atrophic. A fixed maxillary denture was placed over two zygomatic implants and three anterior implants in two surgical stages, and load was applied 6 months after implant placement.

The use of zygomatic fixtures and immediate-loading conventional implants for the rehabilitation of atrophic maxillae is a recent alternative, described in several studies in the literature.[22-26]

According to Duarte et al,[25] zygomatic fixtures have an excellent success rate, but attention should be paid to the basic concepts of this treatment, its correct indication and the experience of the dental surgeon.

The use of complete and removable partial dentures is closely associated with a low masticatory capacity and, consequently, a poor diet, which may lead to low weight and malnutrition, often found among elderly patients.

Implant-supported dentures play an important role in removing the psychological barriers created by the lack of teeth and in reestablishing aesthetics and function, which may lead to improvements in quality of life. The masticatory function of edentulous patients may be rehabilitated with implant-supported fixed dentures to a level similar to that of dentate patients.

Patients rehabilitated with implant-supported fixed dentures have a significant improvement in mastication, function, phonetics and aesthetic quality of the lower third of the face.

According to a study conducted by Duarte, patients rehabilitated with implant-supported fixed dentures had a high mean VAS result (close to 10) in the evaluation of satisfaction, which indicated an improvement in quality of life and made them feel more confident psychologically.

Quality of life should be fundamental in the choice of rehabilitation modality. The number of studies about quality of life and patient satisfaction has increased, and authors, have used questionnaires. The OHIP, which has objective questions about functional limitations, pain, psychological discomfort, physical disability, psychological disability, social disability and discomfort, has been used to evaluate changes resulting from the treatment with implant-supported fixed dentures.

In this study, quality of life was evaluated using the Oral Health Impact questionnaire (Graph 1) and a visual analogue scale (VAS). There were substantial improvements in mastication, word pronunciation and self-confidence. However, the patient also reported greater difficulty in oral hygiene when comparing the implant-supported fixed complete denture and the mandibular removable partial denture that she had before. This difficulty was eliminated by using a water flosser (Waterpik Inc., Fort Collins, CO) for complementary oral hygiene

Conclusion

Implant-supported dentures substantially improve quality of life of patients with ectodermal dysplasia and reestablish aesthetics and function. Further studies should follow up patients with this syndrome who received osseointegrated implants to evaluate long term results.

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Treatment of vertical alveolar defects by means of osteogenic distraction technique

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Abstract

Introduction: Alveolar reconstruction of vertical bone defects remains a daunting challenge in implant dentistry. Among the various techniques used to correct such defects is distraction osteogenesis (DO), which has been described as a technique used to gain bone and soft tissues, especially in surgeries for reconstruction of mandibular and maxillary alveolar ridges to allow the placement of dental implants in a favorable position and with greater success predictability when subjected to functional loads. **Objective:** The purpose of this study was to evaluate the effectiveness of DO in two patients treated with the technique of alveolar distraction osteogenesis. **Case report:** The clinical cases were evaluated for bone gain through clinical and radiographic examination, pre- and post-distraction. **Results:** At the end of treatment, both cases had gained sufficient bone as to enable subsequent rehabilitation with implants. **Conclusions:** The success rate reported in the literature and in the cases presented here prove the efficiency of the technique and its clinical feasibility.

Keywords: Distraction. Implant Dentistry.

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Introduction

Over the years, reconstructive bone surgeries for placing dental implants have been increasingly employed.[1-5] Several strategies in bone tissue engineering have been developed in the last decade.[1,6] More recently, a technique called "distraction: osteogenesis" has enjoyed widespread acceptance.[1,2,6,7,8]

Distraction osteogenesis (DO) is a technique whereby the gradual separation of surgically excised bony margins result in the growth of new bone structure.[6,9,10] The advantages of this technique include the opportunity to obtain a natural bone formation between segments,[6] the ability to achieve greater expansion than other techniques, and decreased likelihood of dehiscence due to a gradual expansion of the surrounding tissues, which promotes neo-histogenesis[2,3,11] in the region.[5,6,10]

Based on the presentation of two duly documented clinical cases in which patients with vertical alveolar bone defects underwent DO, the present study aims to evaluate the application of this technique in parallel to the analysis of clinical success and potential complications.

Cases reports

Two clinical cases were evaluated in terms of bone gain through clinical and radiographic examination before and after distraction to verify the effectiveness of DO technique.

Clinical case 1

The patient, a 31-year-old Afro-Brazilian male, was referred to the Brazilian Association of Dentistry/Bahia State section, with a view to undergoing rehabilitative treatment with implants in the anterior mandible.

After thorough clinical and radiographic examination, the absence of mandibular incisors was noted, as well as severe vertical bone loss, for which bone distraction surgery was indicated as a therapeutic option (Figs 1, 2 and 3).

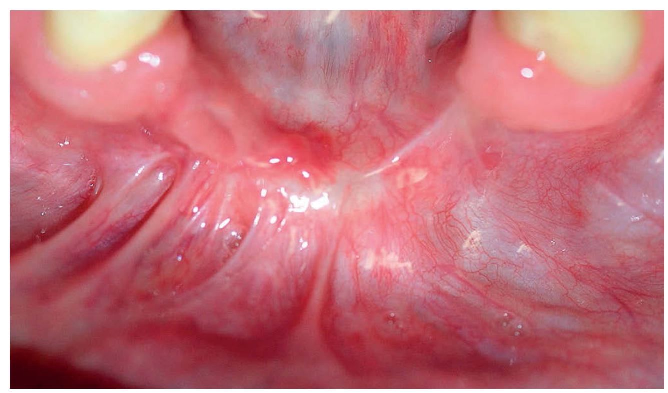

Figure 1 - Patient's initial condition.

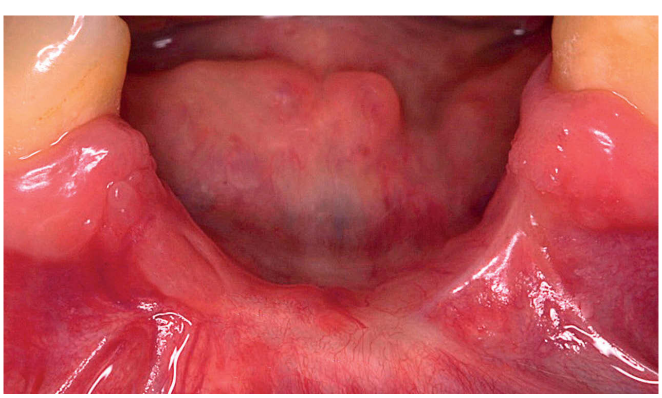

Figure 2 - Large vertical bone defect observed.

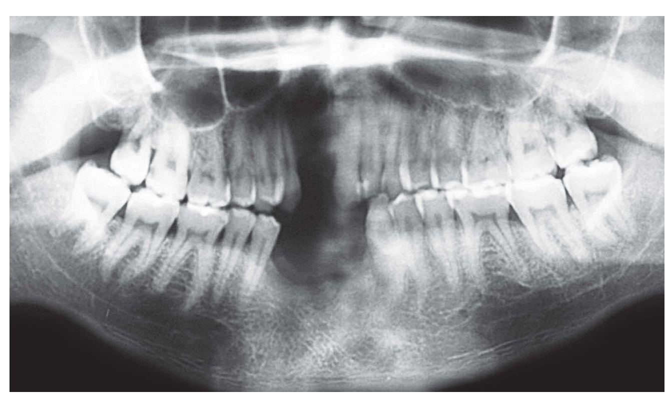

Figure 3 - Initial radiograph of the case.

Bone distraction involves a surgical phase, latency period, distraction phase, and a second latency period. The final, rehabilitative phase is then begun.

In the surgical phase, a horizontal incision was performed limited to 5 mm of the crest of the bone ridge located under the gum tissue (previously grafted), total flap detachment, followed by adjustment and screwing of intraoral distractor (Connection®) on the bone bed in order to delimit the area selected for osteotomy. Thereafter, the distractor was removed and osteotomy performed with surgical drills, imparting a trapezoidal, slightly expulsive shape to the bone block (osteotomy of the lingual cortex was also performed with the aid of a chisel (Figs 4 to 7). After block preparation, the distractor was fully activated to test its functionality, eventually returning it to its original position (Fig 8). Finally, the soft tissues were sutured with 5-0 nylon (Fig 9) and then a temporary perforated denture was placed.

During the latency period, the distractor was kept immobile in the surgical region for 7 days, and the posterior distraction process involved an activation rate of 0.7 mm per day (two complete turns). During these stages, the surgery was monitored and controlled, which confirmed a sudden mobility of the distractor during activation on the fifth day following the surgery.

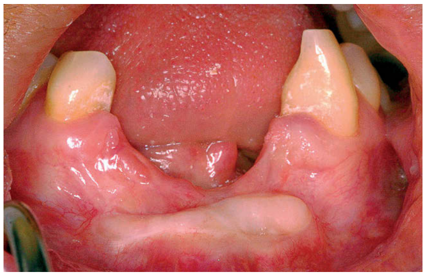

Figure 4 - Region after healing of free graft.

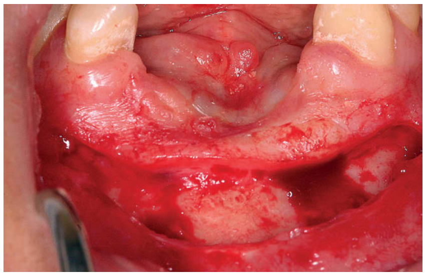

Figure 5 - Incision and initial detachment preserving lingual tissue and bone crest.

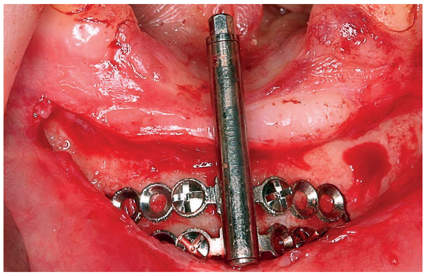

Figure 6 - Distractor fastened, delimiting the osteotomy area.

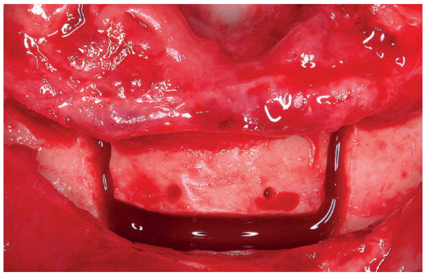

Figure 7 - After osteotomy.

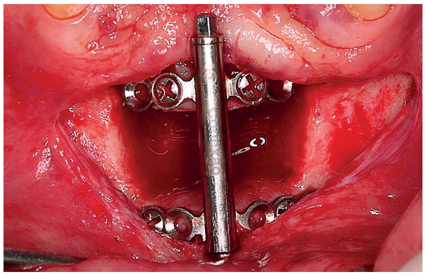

Figure 8 - Full activation of the distractor to eliminate potential interference.

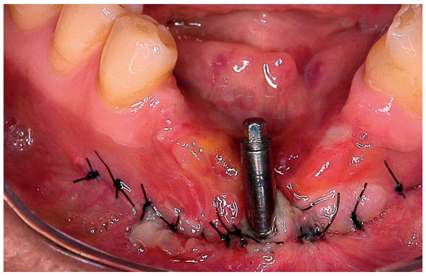

Figure 9 - Final suture.

The surgery site was explored, with a rupture being detected in the distractor, more specifically in the spot weld of the guiding rod (Fig 10). The distractor was removed, a new device was installed, and a new latency period (7 days) initiated with the device being activated 1.05 mm per day, in single movements, for 9 days. The device was also immobilized for a period of 4 months (Fig 11), and it was recommended that the area be cleaned with chlorhexidine at 0.12%.

After this period, a panoramic radiograph was taken, which showed a satisfactory gain of bone tissue in the area between the distractor plates (Fig 12). In the rehabilitation phase, the site was reopened, the distractor removed and two 3.75 x 15mm implants (SIN®, National Implant System) placed (Fig 13). Two months after implant placement, a temporary denture was screwed onto the implants (Fig 14). The patient is currently scheduled for placement of a permanent denture.

Figure 10 - Distractor fractured.

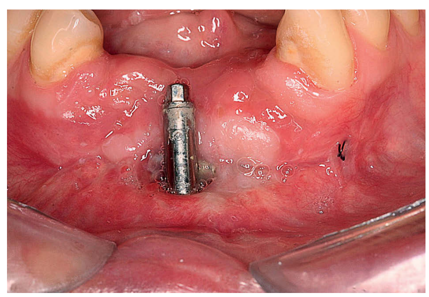

Figure 11 - View after completing distractor activation.

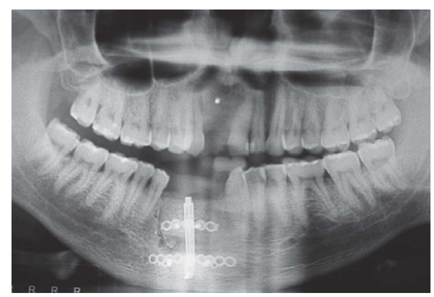

Figure 12 - Radiograph after latency period showing growth achieved with the technique.

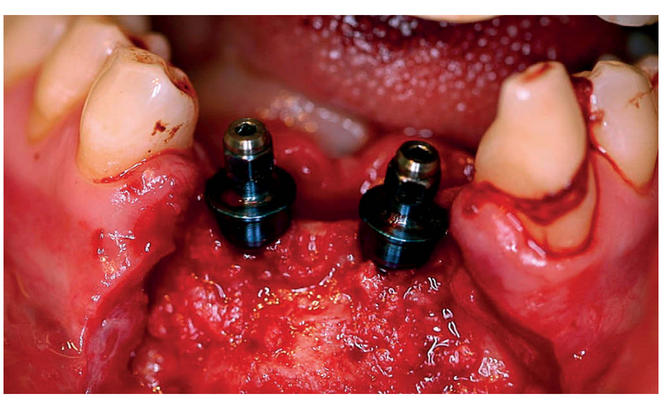

Figure 13 - Placement of implants.

Figure 14 - Implant-supported temporary denture in place.

Clinical case 2

The patient was a 23-year-old Afro-Brazilian male, with a history of injury by firearm two years earlier, resulting in a mandible fracture. The fracture was treated by the oral and maxillofacial surgery and traumatology team of Santo Antônio Hospital, Bahia State Federal University (UFBA), and the patient's anterior mandible rehabilitation was planned for one year thereafter.

Clinical and radiographic examination (Figs 15 to 18) showed marked bone loss in the anterior mandible, a factor that precludes rehabilitation treatment with dentures. It was decided, therefore, to perform bone distraction surgery and subsequent implant rehabilitation at the Implant Dentistry clinic of the Bahia State Federal University.

Figure 15 - Initial clinical condition (right side view).

Figure 16 - Initial clinical condition (front view).

Figure 17 - Initial clinical condition (left side view).

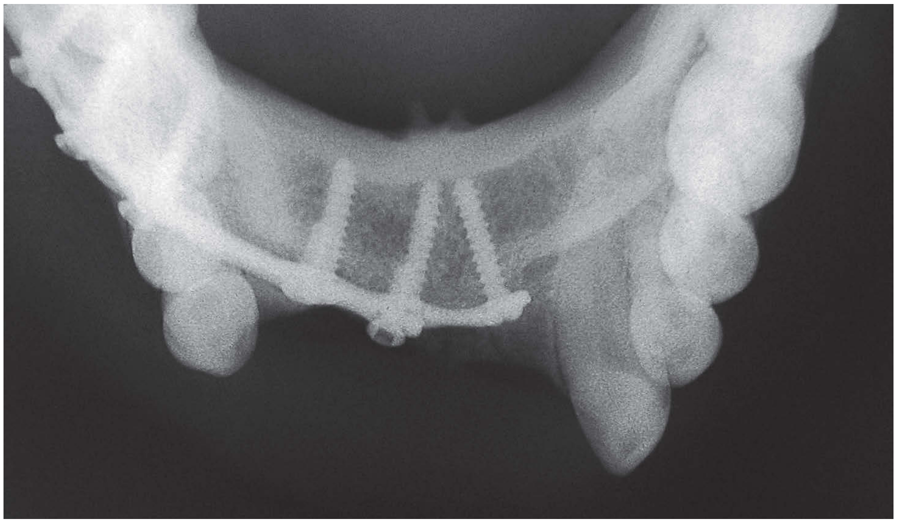

Figure 18 - Initial radiograph.

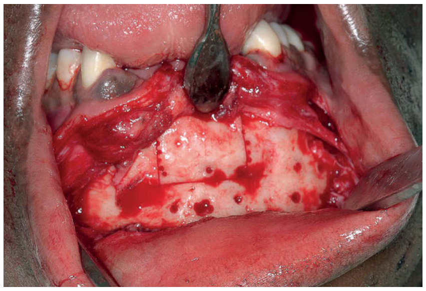

Figure 19 - Osteotomy.

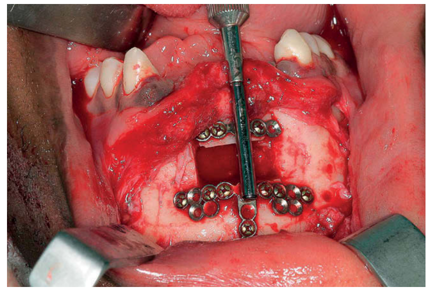

Figure 20 - Testing distractor in place.

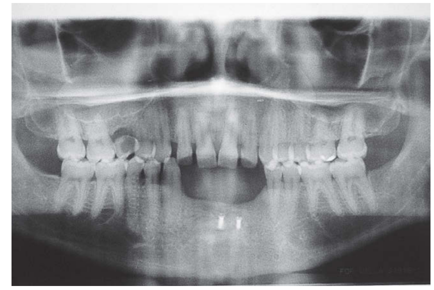

Figure 21 - Panoramic radiograph of jaws after distraction.

Performance of bone distraction involved the same phases mentioned in the previous clinical case, i.e., Surgical phase, latency period, distraction phase, second latency period and rehabilitation phase.

The surgical phase involved a horizontal incision in the crest of the bone ridge with two relaxants in the symphysis region, total flap detachment, followed by removal of rigid internal fixation, adjustment and screwing of intraoral distractor (Conexão®) onto the bone bed in order to delimit the area selected for the osteotomy. The distractor was then removed and osteotomy performed with surgical drills, imparting to the bone block a slightly expulsive, trapezoidal shape, (lingual cortex osteotomy was also carried out with a chisel) (Figs 4 and 7). The distractor was activated maximally and then returned to its original position (Fig 20). Finally, the soft tissues were sutured with 5-0 nylon.

The latency period lasted 7 days and the posterior distraction procedure involved activation at a rate of 0.7 mm per day (two complete turns) during 9 days. During these steps, the surgery was monitored and controlled. On the tenth day, the distractor was immobilized for a period of 4 months, with a recommendation to sanitize the area with chlorhexidine 0.12%.

After this period, the site was reopened to remove the distractor and onlay grafts removed from the jaw to thicken the area where the distraction had been performed. Panoramic radiography revealed that there was satisfactory gain in bone tissue between the plates (Fig 21).

Currently, the patient is scheduled for placement of dental implants in that region.

Discussion

The stress generated by applying tensile strength to the tissues metabolically activates cells of the affected area, thus increasing the mitotic index and protein synthesis.[12] Preserving the tissues during osteotomy is essential for maintaining the vitality of the transport segment.[6,13] In this study, an incision was performed over the alveolar bone crest, leaving a wide band of attached tissue on the bone crest, thus preserving the periosteum and tissue structure in the lingual area.[4]

Although the stability of the distraction device is critical in new bone synthesis processes,[4,6] one cannot lose sight of the importance of a stable fixation, a condition that provides the intramembranous formation[2] of a bony callus within a short period of time[6,12] due to high oxygen saturation in the surgical wound. It should be borne in mind that micromovements may be responsible for a decrease in oxygen concentration in the bony callus, leading to slower endochondral type ossification with prior formation of fibrocartilages and occasional bond failure of the segment.[4,12]

The latency period is the period between osteotomy and early activation of the distractor.[4,6,12] The histological sequence during the latency period is similar to fracture healing.[6] Clinically, a latency period of seven days appears to be more efficient. However, the age of the patient as well as local conditions are factors that may determine postponement or curtailment of this time frame.[4,12] Distraction rhythm is paramount for a successful procedure. Activations of less than 0.5 mm per day could lead to premature ossification of the fragment, while 2 mm activations can lead to fibrous filling of the regenerating area[4,12] as well as ischemia in the tissue undergoing formation, which results in bone resorption, or else deficient fragment bonding.[4] A range between 0.5 mm and 1 mm per day is ideal for both long bones and bones in the craniofacial complex.[4,10,12] Finally, the consolidation period takes place between the end of the distraction and distractor removal, which must be held immobile in the region until removal.[12] The time length reported in the literature for consolidation ranges from 3 weeks to 3 months.[4] In the cases reported here, a period of four months proved satisfactory in meeting the expected functional and aesthetic requirements.

A multicentric,[2] prospective study conducted with 34 patients who had undergone distraction surgery and placement of 138 implants showed a cumulative success rate of 94.2% four years after placing the dentures. However, in another prospective study with humans,[13] after 5 years' intervention the researchers responsible for the study reported having achieved a 90.4% success rate of implants placed in the region subjected to distraction. In comparing alveolar bone distraction with the technique of guided bone regeneration, McAllister and Gaffaney[13] found positive results for both techniques. However, bone resorption detected before and after implantation was higher in the group treated by guided bone regeneration (GBR). This finding led the authors to attribute greater predictability and a better prognosis for patients treated by bone distraction.[8]

Although the incidence of complications in distraction osteogenesis is relatively low, important studies[14] reported on the possibility of fracture occurring in the transport segment, handling difficulties due to the length of the activation rod, difficulties in finishing osteotomy in the lingual region, incorrect direction of the distraction vector,[9] perforation of the mucosa on the distraction disc, suture[15] dehiscence, infection and injury to the nerves and adjacent teeth.[11]

However, another major retrospective study[15] involving complications in 72 distraction cases indicate that 56.95% of cases were treated without complications, versus 43.05% of patients who had some type of complication when subjected to this technique. Most complications were classified as minor, such as edema, infection, small dehiscences, excessive inclination of the transport disc and paresthesia. The major complications surrounding the fracture of the device were scar tissue formation, fracture and resorption of the transport segment, fracture of bony structures or large dehiscences.[15] In the present study there was a fracture in the distractor in the first case reported, necessitating further surgery to remove the fractured distractor and insertion of a new distractor.

In the case reports presented in this article, the performance of successive clinical and surgical procedures yielded successful results, with proven vertical gain of alveolar bone, although segment transport in a contaminated area such as the mouth can be considered critical.

Conclusions

Distraction osteogenesis as described in this article has proven a safe surgical alternative to the vertical reconstruction of alveolar bone ridges. However, mastery of a detailed technique and patient cooperation are key elements for a successful treatment. A careful evaluation of each case should yield the benefits outlined in the proposed technique since the occasional loss of a transport segment can compromise rehabilitation. The high success rates described in the literature show that the technique is both effective and clinically viable, which is further attested by the cases presented in this article.

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Characterization of implants surface of the five largest companies in the Brazilian market, on micrometric level. Part III: SIN implants

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Abstract

Introduction: The quality of the bone-implant interface is directly influenced by implant surface roughness and a roughness average, with the S_a between 1 to 2 µm, has demonstrated better clinical and laboratory results. In Brazil, more than two million implants per year are installed, where 79% are manufactured by domestic companies. However, very little is known or published about the characterization of surfaces of these implants, on the micrometer level. The aims of this study are to evaluate and characterize numerically the surface of the implants of SIN (Sistema de Implante Nacional) company, one of the five largest companies in the Brazilian market. **Methods:** Were evaluated a total of 6 implants, purchased directly on the market, of two different designs (Tryon-HE and Strong-SW) and different batches, using light interferometry. Were performed 9 measurements randomly chosen for each unit, 3 on the tops, 3 on the valleys and 3 on the flanks of the threads. The same pattern was followed for evaluation by scanning electron microscope. **Results:** The analyzed implants from this company showed S_a values of 0.84µm for Tryon-HE and 1.01 µm for Strong SW. Comparing the batches, only the SW design showed statistically significant differences between them. **Conclusions:** The roughness values found herein categorize the surfaces of Tryon-HE as minimally rough, and Strong-SW implants as moderately rough.

Keywords: Dental implant. Brazilian implants. SIN implants. Implant surface. Roughness.

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Introduction

An important parameter for the clinical success of osseointegrated implants is the formation of direct contact between implant and surrounding bone.[1,2] The quality of the bone-implant interface is directly influenced by the roughness of the implant surface[3-8] which was identified as one of six particularly important factors for the incorporation of implant into the bone from the beginning of the 80's.[3]

Both morphology and surface roughness have an influence on the proliferation, cell differentiation, extracellular matrix synthesis, local production factors and even on the cell shape.[8,9] Fixing mechanisms used by cells on the implant surface determine its shape and the transmission of signals through their cytoskeleton resulting in the expression of specific phenotypes. Furthermore, the shape of the cell regulates the growth, gene expression, protein secretion, differentiation and apoptosis.[10]

The osteoblast adhesion on the implant surface is not sufficient for obtaining the osseointegration, or even improves it, but it is necessary particularly for the cell to receive signals in order to induce their proliferation.[8] Moreover, roughness do not only facilitate the retention of osteogenic cells, but they allow them to migrate on the implant surface by osseoconductivity.[11] A faster and stronger bone formation provides higher stability during the repair process, allowing even a faster loading of the implant.[5,6,7]

The oral implants surfaces have measurable structures in macrometric scale in millimeters (mm), micrometric scale in micrometers (μm) and nanometric scale in nanometers (nm).[5,7,8,12,13,14] The objective of several publications and studies in this recent years is how these structures influence the repair.[6,13,15-18]

So far, the certainties are limited to the influence of implant design and roughness in micrometric scale. A screw-shaped design and a surface with a mean roughness, S_a of 1-2μm , show better results.[6,7,8,12] Studies have shown titanium implants with appropriate roughness can improve the bone-implant contact[19] and also increase the force of the extraction torque.[19,20] On the other hand, increasing the surface roughness higher than 2μm of S_a causes an impaired and unreinforced bone response.[5-8]

Over the past 20 years, a high number of implant systems with different surface topographies was added.[17] Oral implants are an example of the close binding between research and industry, as the laboratory findings often become clinical applications.[1]

Brazil is currently one of the largest implant markets of the world with an annual consumption estimated at 2.000,000 (two million) units which 79% are manufactured by national companies (Survey on the Status of Implantology in Brazil — Implant News, Survey 2010). SIN (São Paulo) is one of the five largest companies in Brazil.

But it is disclosed or known very little about the physicochemical characteristics of the surface of their implants, thus limiting the information contained in the leaflet and in its catalog.

This study aims to characterize the surfaces of two different SIN designs: Tryon-HE and Strong-SW, and describe them within the international standard developed by Wennerberg and Albrektsson[5]. Data found are described and evaluated with the expectation in the treatment used, comparing them with Osseotite® implants, made by Biomet 3i, used as reference since they use the same type of treatment and have solid publishing in worldwide literature.

Material and Methods

Methods used to evaluate the implant surface was proposed by Albrektsson and Wennerberg in 2000[5], and became a worldwide standard for evaluating the implant surfaces.

Therefore, three measurements were carried out in different areas for each implant, from the tops, valleys and flanks of the threads (Fig 1), with a total of nine measurements for each unit. Furthermore, three samples were evaluated in different batches for each implant to permit evaluation of the regularity of production process, and they are separated in samples 1, 2 and 3. Following this pattern, three implants of each of the following designs made by SIN, were purchased directly in the market: Tryon-HE (Fig 2) and Strong-SW (Fig 3).

Scanning electron microscopy images were also performed (Quanta 200) from top, flank and valley of threads in the upper, middle and lower thirds, with a total of 9 areas assessed. Magnifications of 65X, 350X, 1,000X, 3,000X and 5,000X were used.

The objective of those images was to undertake a qualitative analysis of the modifications achieved by the surface treatments, by observing the roughness characteristics and whether they upheld the same pattern throughout the entire body of the implant.

Then, one of implants sample was cut transversely for polishing metal and underwent the EDS analysis, the energy dispersive spectroscopy, used to identify elements present in the surface to ensure the titanium used by the company, checked that described in the leaflet.

Surface treatment

SIN implants surfaces are treated by acid etching, that removes the outer layer of titanium oxide from

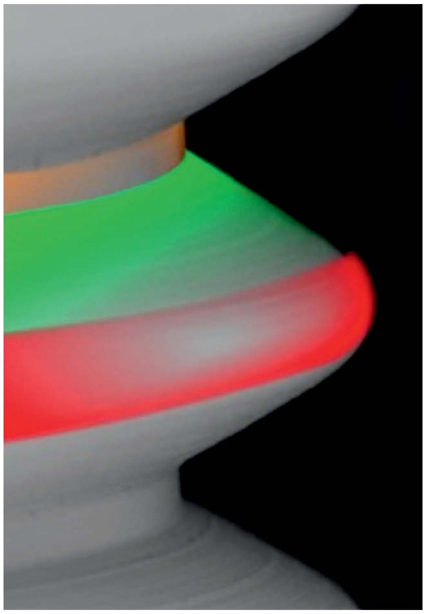

Figure 1 - Red = top; green= flank; orange= valley.

Figure 2 - SIN Tryon-HE Implant. Lots evaluated: Lot 01 – IO0173; Lot 02 – H71070; Lot 03 – G60337.

Figure 3 - SIN Strong-SW Implant. Lots evaluated: Lot 01 – I10960; Lot 02 – I90543; Lot 03 – H80750.

the surface and portions of the layer immediately below the surface, creating microcavities of different depths, with a new oxide layer being immediately formed on the new surface. The amount of removed material and the characteristics of the irregularities that are created depend on the type and concentration of the acid as well as on its temperature and treatment time, and obviously, on the type of titanium employed.[6,8]

Acid etching usually leads to a slight increase in roughness. It should be noted, however, that different features may increase or decrease the irregularities.[6]

Each manufacturer has a unique method to carry out this treatment. Usually, double acid etching is performed by first immersing the implant in acidic solutions, among which are: HCl, H_2SO_4, HNO_3, HF or any combination of these. Then, the implant is immersed in an aqueous solution of HNO_3 to stabilize an oxide layer.[6,8]

Surface analysis

Implant surfaces were evaluated using a light Interferometer (MicroXAM™, Phaseshift, USA) is indicated to evaluate roughness of the implant with threads at micrometric level.[5] We use an objective of 50X and a zoom of 0.62. The measured area was 264 X 200 μm, while the average height of measures ranged between 80 μm and 100 μm. The maximum resolution of this technique is 0,30 μm horizontally and 0.05 μm vertically.

To be able to adequately describe the roughness obtained with the treatment, the undulations of machining process and shape are considered separately. A standard filtering process using a Gaussian Filter of 50 X 50μm was used to perform this separation and assessment of the micrometric roughness (Fig 4-7). For this, the Surfascan software (Somicronic Instrument, Lyon, France) is used, which also provides visual images and numerical descriptions. For the numerical description of the surface topography which should preferably be in 3D, the following parameters are used:

a) S_a: Represents the arithmetic mean for height of peaks and valleys, surface roughness in the median plane.
b) S_{ds}: Represents the density, in other words, number of peaks per area unit.
c) S_{dr}: Hybrid parameter representing the increase in area obtained.

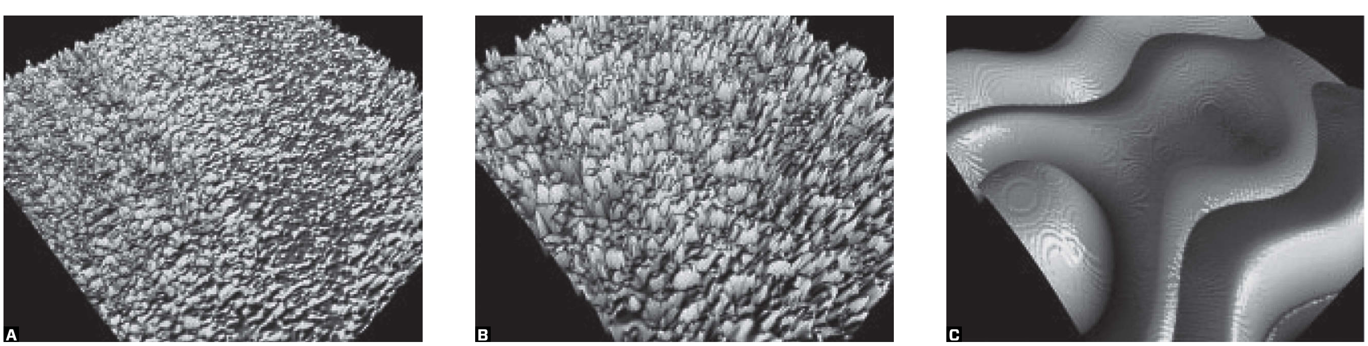

Figure 4 - **A**) Original Nanotite, **B**) Nanotite with 50X50Ÿm Gaussian filter, **C**) Nanotite with 50X50Ÿm Gaussian filter (low pass)14. Sequence of filters in which the undulations and shapes are removed.

Implants can be divided into 4 different categories, depending on the surface roughness measured by the value of S_a:[12] smooth (S_a < 0.5 μm); minimally rough (S_a between 0.5–1.0 μm), moderately rough (S_a between 1.0–2.0 μm); Rough (S_a > 2.0 μm).

Statistical analysis

Implants were evaluated for significant differences in surface topography at micrometric level. Statistical analyzes were performed using GraphPad Prism 5,0 (GraphPad Software, San Diego, USA). Results were analyzed using Kruskall-Wallis test with significance level of $p < 0.05$, and Dunn's multiple comparison test was applied, also at a significance level of $p < 0.05$.

Results

Characterization of surface

Table 1 shows the values obtained, as well as the implant used as reference for comparison to the values found and published by Svanborget al.[14]

In Figure 5, images of interferometer analysis generated by the Surfascan were observed along with the obtained in the SEM with a magnification of 3,000X. Images were selected from the flanks of the thread in the middle third of the implants. Following detailed images of scanning electron microscopy in 3 different magnifications of Tryon-HE (Fig 6) and Strong-SW (Fig 7) implants evaluated, as well as the Osseotite implant surface used as reference (Fig 8).

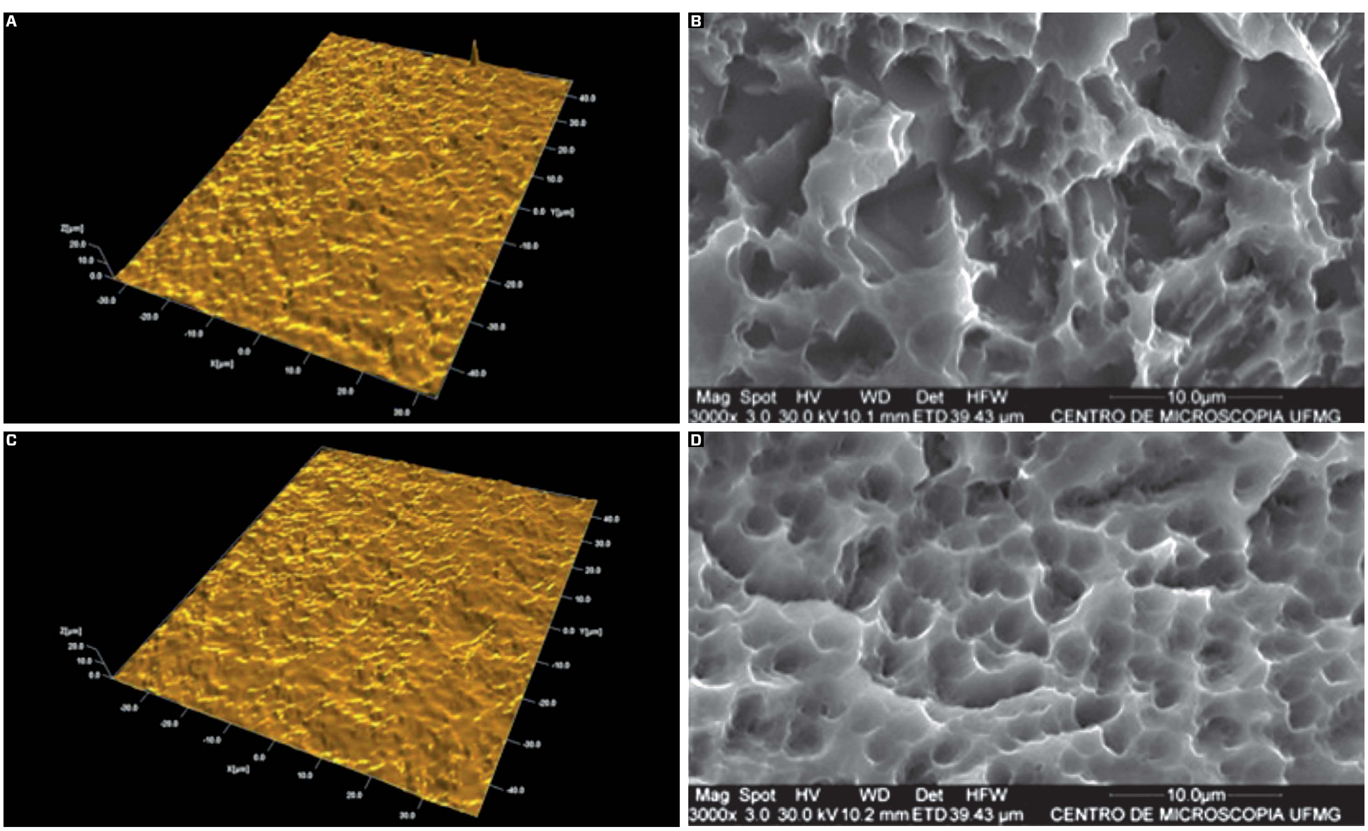

Figure 5 - Images of the interferometer (left) and SEM (right), 3,000x magnification. **A**, **B**) SIN Strong-SW; **C**, **D**) SIN Tryon-HE

Table 1 - Numerical description of the SIN implant surface topography, in micrometric level.

	S_a µm	S_{ds}/mm²	S_{dr}%
SIN Tryon-HE	0.84 ± 0.23	164.463 ± 8.680	47.47 ± 17.68
SIN Strong-SW	1.01 ± 0.35	165.051 ± 15.426	92.67 ± 41.73
3i Osseotite®	**0.66 ± 0.05**	**140.441 ± 8.321**	**26.80 ± 4.02**

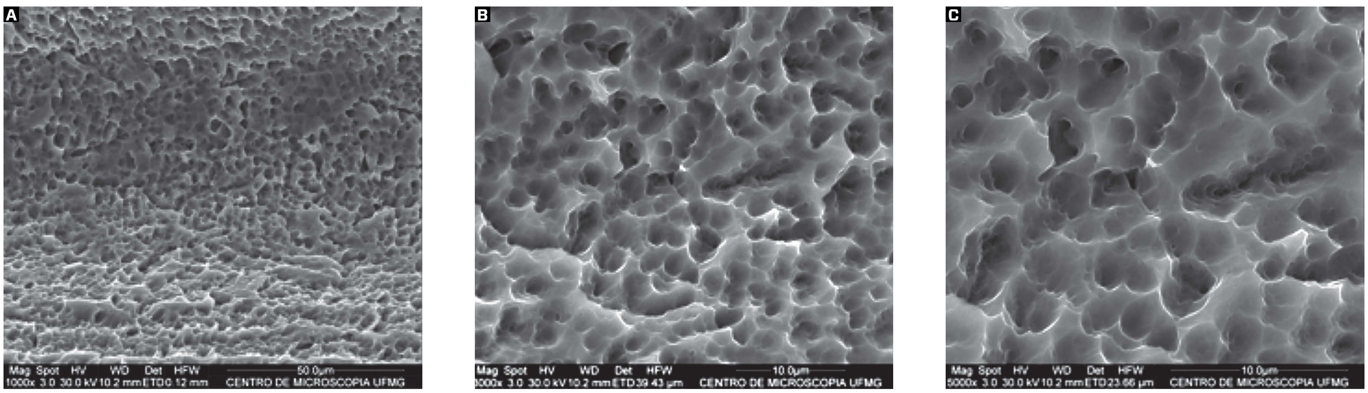

Figure 6 - SEM images of Tryon-HE implants (**A**: 1,000x, **B**: 3,000x, and **C**: 5,000x).

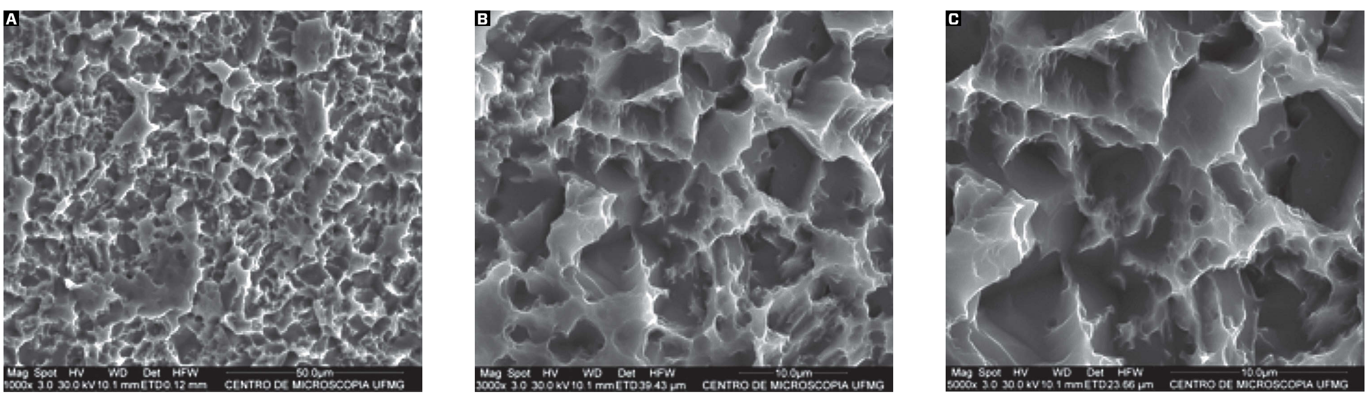

Figure 7 - SEM images of Strong-SW implants (**A**: 1,000x, **B**: 3,000x, and **C**: 5,000x).

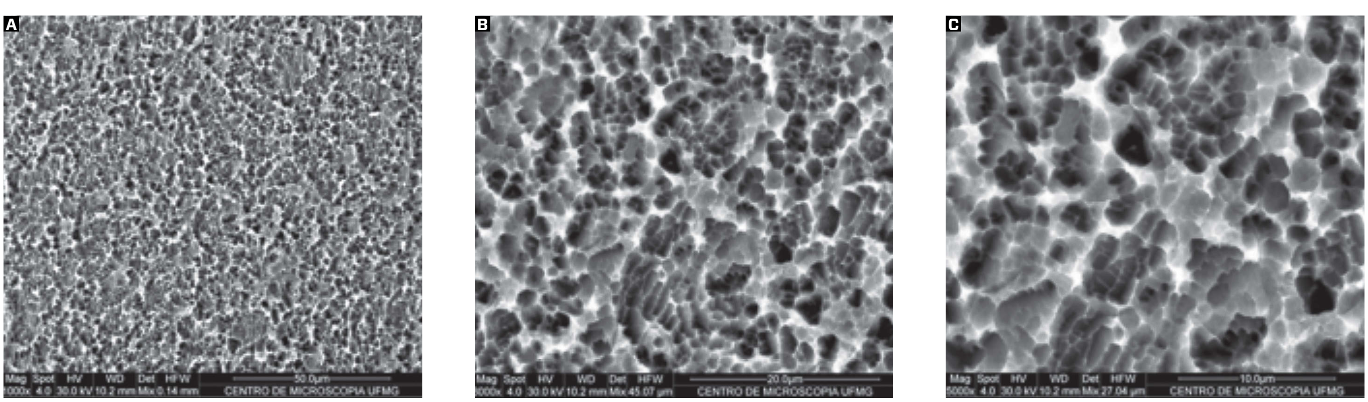

Figure 8 - SEM images of Osseotite® implants, by Biomet 3i (**A**: 1,000x, **B**: 3,000x, and **C**: 5,000x).

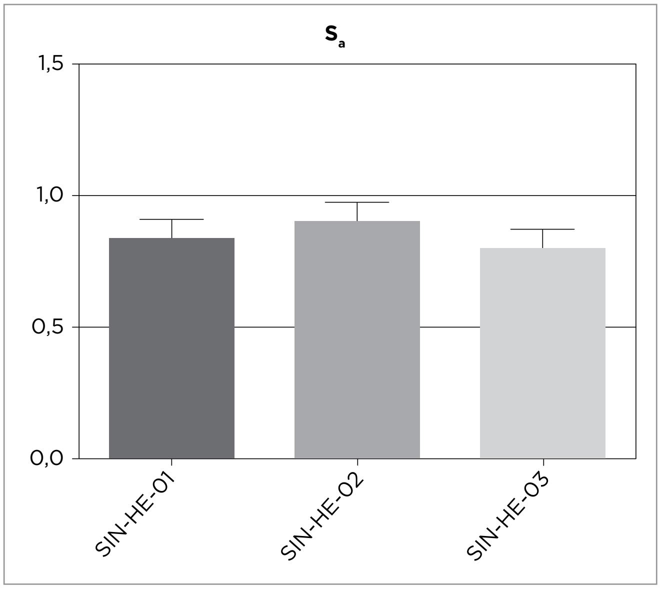

Figure 9 - Representation of S_a values for Tryon-HE implants.

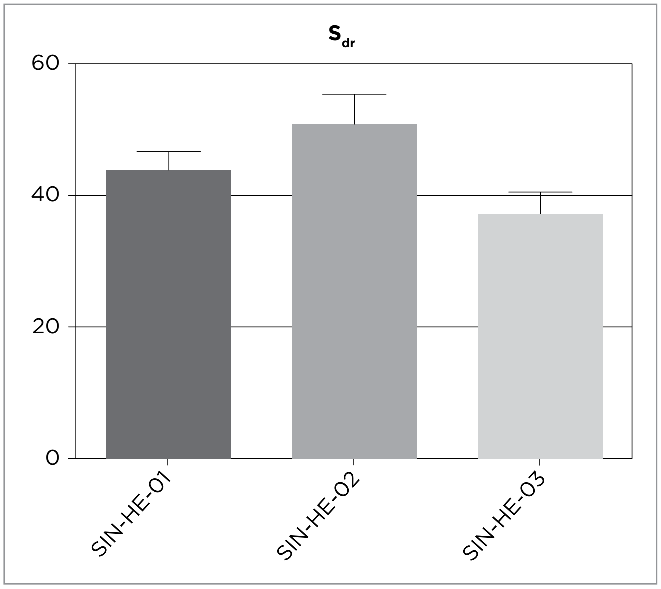

Figure 10 - Representation of de S_{dr} values for Tryon-HE implants.

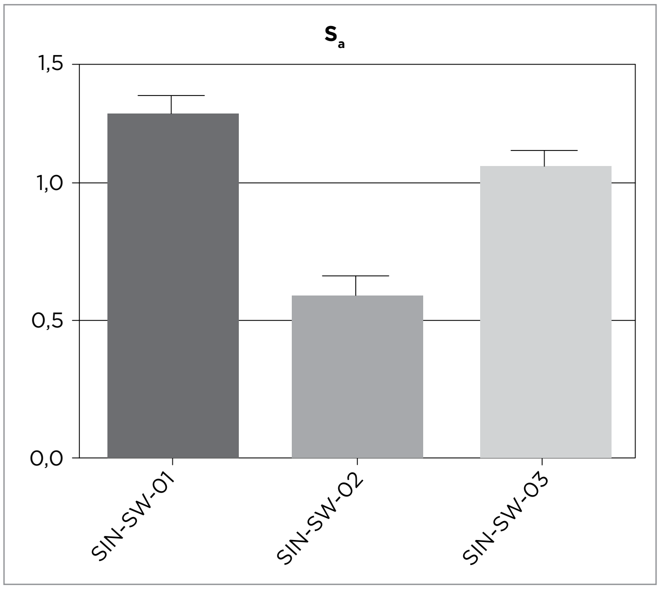

Figure 11 - RRepresentation of S_a values for Strong-SW implants.

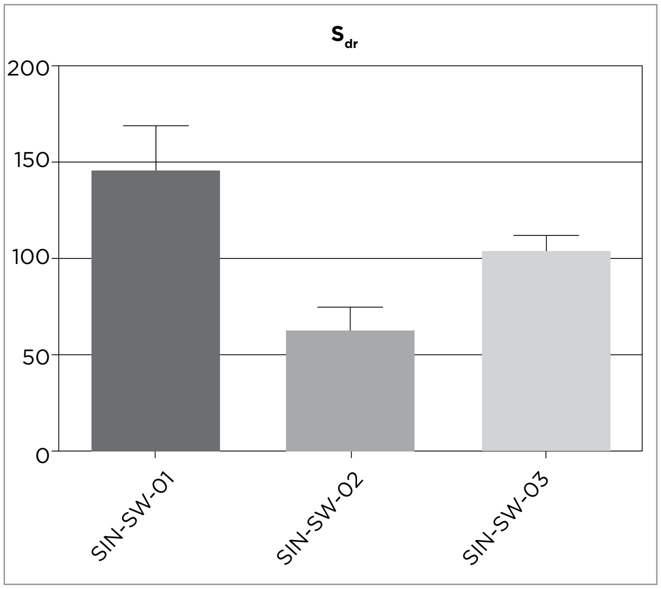

Figure 12 - Representation of S_{dr} values for Strong-SW implants.

Comparing the different lots

Analysis was performed separately for each design, because herein does not fit any comparison between them. In addition to this, comparison will be made only regarding the S_a and S_{dr}. For statistical analysis, the Prism software was used, and as the distribution was not normal, we applied the Kruskal-Wallis test ($p < 0.05$) as well as Dunn's multiple comparison test, also at a significance level of $p < 0.05$.

Tryon-HE

These implants displayed a fairly regular pattern between lots, with S_a values of 0.83 µm for Lot 01, 0.89 µm for Lot 02, and finally 0.79 µm for Lot 03 (Fig 9). Likewise, S_{dr} values were very close to each other, with 44% in lot 01, 50% in Lot 02, and 37% in lot 03 (Fig 10). Therefore, there were no statistically significant differences between the values in both parameters.

Strong-SW

This implant design displayed statistically significant differences between S_a values for Lot 02, with 0.62 µm, and Lots 01, with 1.30 µm, and 03, with 1.08 µm (Fig 11), as well as in S_{dr} values between Lots 01, with 117%, and 02, with 62% (Figure 12).

EDS of the implants

The EDS analysis results for both SIN implant designs indicated the use of titanium grade-4 (ASTM F67),which is fully in accordance with the specifications given in the product description. Figure 13 presents the spectrum of the Strong-SW implant and will serve to demonstrate the chemical composition of both evaluated implants from SIN.

Discussion

When the implants started to be manufactured in Brazil, most companies chosen designs and implant surface treatments established, with extensive scientific publication and strong presence in the Brazilian market. SIN was chosen dual acid etching as the surface treatment, in the manner of Osseotite® surface, of Biomet 3i, USA. One way to evaluate the obtained results is to compare them with the values obtained from reference implants, using the same standards and backed by vast scientific evidence. Certainly, these considerations led SIN to use the Osseotite® implants as reference, and follow their model.

Among the parameters evaluated, the most representative ones for the analysis of a surface are S_a, representing the arithmetic mean of peak and valley heights of the surface roughness in 3D and S_{dr} representing the increase in surface area obtained with treatment. Analysis of these factors and previous knowledge of its influence on the repair processes allows a behavior signaling of certain surface.[7,12,22]

The SIN implants, that use grade-4 titanium, showed an S_a of 0.84 µm for Tryon-HE and 1.01 µm for Strong-SW — therefore, displayed by the reference implant,

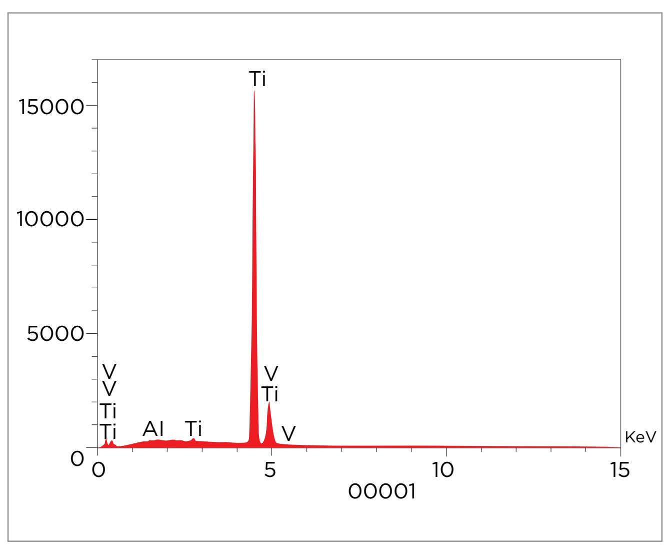

Figure 13 - EDS spectrum showing the elements present in the sample of the SIN Strong-SW implant. The x-axis represents the energy of the corresponding element, and the y-axis, the x-ray photon count.

i.e., Osseotite,® at 0.66 μm,[14] but however, uses grade 2 titanium in its manufacture, which favors the quality of repair. Nevertheless, it should be highlighted that not even the reference implant features the roughness regarded as ideal (between 1.0 and 2,0 μm) following acid etching. In general, this etching leads to a slight increase in roughness and, in fact, many consider Osseotite® implants to be too smooth to be ideal.

A similar result was found in evaluating S_{dr}, with SIN implants achieving higher values than Osseotite®, which displayed an S_{dr} of 27%,[14] while Tryon-HE showed 47%, and Strong-SW, 92%. Theoretically, this combined increase of roughness and surface area benefits repair, but should be further investigated through comparative clinical studies.

For both evaluated SIN designs, the values of S_a and S_{dr} alike, as well as the topographic characteristics observed in SEM images (Figs 8 and 9), were quite different from one another. Since the company employs the same surface treatment process for both implant designs, the difference found is due to the influence of the macro design of the implant obtained by microtopography. As demonstrated by Wennerberg and Albrektsson,[6] when the macrometric topography of a given surface is changed, its micrometric characteristics may also undergo concurrent changes, even if accidentally.[7,19,23,24,25]

An analysis of the SEM images evidences topography typical of a surface submitted to acid etching. In addition to the previously mentioned differences between the two evaluated SIN implants, both also proved to be topographically different from the Osseotite® implant (Fig 10), which reinforces the variability inherent to acid etching.

As with the methodology employed, EDS analysis allows to state only on the percentage of chemical elements found, which are fully consistent with the leaflet of the implants, and they point to the use of Titanium ASTMF F67 grade 4 in their manufacture. In this analysis, it is not possible to make any consideration on the existence or absence of contamination or any metal or material on the surface of the implants.

In comparing among batches, there was a statistically significant difference only among Strong-SW implants. According to the method employed, the assessment of two more samples from the batch 02 of this implant. For this, the company was contacted in order to concede these implants for further analysis. However, as those stock batches were no longer found, the company sent three new samples from the same batch for each design distinct from those first evaluated. Herein, it is noteworthy that the implants of the first assessment were acquired directly in the market. In the subsequent analysis of the new samples, there was a statistically significant difference between the evaluated implants for S_a values of sample 3 (0.89 μm) compared to samples 1 (0.45 μm) and 2 (0.43 μm). This also occurred for the values of S_{dr}, which samples 1, 2 and 3 presented, respectively, 25%, 26% and 39% of S_{dr}. Moreover, there was a statistically significant difference between the mean values of S_a and S_{dr}, presented by the first group of implants to be evaluated (S_a of 1.01 μm and S_{dr} of 92%) compared to that obtained by the other group in the second analysis (S_a 0.61 μm and S_{dr} 30%). These differences indicate that the company must reassess the level of control of its process of surface treatment.

To know what these differences really may represent, further investigations are required. It can state the similar treatments do not show the same results.[6,7] Even only machined surfaces may vary considerably in roughness, as well as blasted surfaces with acid conditioning or anodized.[6,7] Many studies and companies omit the topographic characterization of the surface because they believe the treatment alone will determine the optimum roughness of this surface.[6]

As it was already stated,[6,7] when the macrometric topography of a certain surface is changed, the micrometric and chemical characteristics may be changed at the same time, even accidentally. Therefore, it is essential the surface treatments are appropriate for each implant design in order to obtain the desired roughness.

Conclusions

Even if companies use consecrated techniques of surface treatments, it is important to invest in ongoing laboratory experiments to evaluate the results, its standardization and regularity.

In addition of course, to conduct clinical studies both prior as to subsequent releases of their implants, to validate its effectiveness and evaluate their influence on osseointegration, success rate and longevity.

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Clinical surgical analysis of implant installed immediately after tooth extraction

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Abstract

Introduction: In the beginning of Implantology, the conventional protocol for osseointegration suggested waiting until twelve months for the process of alveolar bone's repair before the placement of an implant. However, osseointegrated implants can be installed after tooth's extraction at various moments. The choice of this depends on bone, functional and esthetic aspects. The insertion of an implant in the tooth socket immediately after tooth's extraction, called immediate implant, shows a technique of oral rehabilitation quite viable and science reports high rates of success, especially in the anterior region of maxillary, where there is need to obtain satisfactory esthetic results. The main indication of this is the replacement of teeth that have no possibility of treatment. This technique is very advantageous because it takes advantage of the cellular repair period, reducing surgical time, providing immediate installation of the prosthesis, function or just esthetic, which brings great satisfaction to the patient. To reach success, the practitioner must be aware of some limiting factors that may indicate against the use of the technique. **Objective:** The purpose of this article is to show the advantages and disadvantages of this technique and its indications and contraindications through a literature review.

Abstract: Oral surgery. Dental implants. Tooth extraction.

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Introduction

Due to the high rate of edentulous individuals, either in whole or in part, associated with widespread dissatisfaction with conventional methods of treatment, the use of dental implants has shown significant growth. With the advancement of scientific research, numerous studies have been conducted in the field of Implant Dentistry, with the objective of perfecting techniques and materials used, making the treatment less traumatic and more aesthetically pleasing.

After the discovery of the principle of osseointegration by Professor Per-Ingvar Brånemark, dental implants have gained much credibility within the scientific community. The considerable bone reabsorption resulting from the loss of a tooth, reducing the treatment time and the final aesthetics of the patient were some of the factors that drove research on the application of dental implants immediately after extraction. This technique was given the name of Immediate Implants.

The implant applied immediately after tooth extraction has been considered a routine procedure in clinical dentistry. The advantages of immediate implantation are:

- Elimination of time waiting for repair of the socket and periodontal tissue regeneration, thus a consequent reduction in the cost of treatment.
- Reduction of surgical time by eliminating a second surgical intervention for implantation.
- Maintenance of the size of the socket in both height and thickness which leads to the required architecture of adjacent soft tissues.
- Less exposure period of the surgical aperture to external agents, reducing bone reabsorption and maintaining adequate biological spaces and interdental papilla.
- And especially, the reduction in the period of missing teeth, a fact that increases acceptability by the patient.

However, it is necessary to evaluate some of the preconditions for immediate implantation, such as the length of bone reabsorption, bone defect morphology and positioning the implant to provide an ideal position for finishing work that will result in an esthetically pleasing restoration.

To be successful at this technique, the professional must be aware of some limitations: Bone's quantity and quality in the region that focuses on obtaining primary stability; anatomy of the tooth's root that will be extracted that will determine the morphology of the residual socket, age, health and habits of the patient must be analyzed during an initial visit and may negate this treatment.

Literature review

The original Brånemark protocol recommended a waiting period for nine to twelve months after the tooth's extraction, before insertion of any implants, so as to allow complete formation and maturity of the alveolar bone. Recent studies show that the tooth's extraction induces 23% of reabsorption of the bone crest after a period of six months, occurring severe modification of the hard and soft tissue's architecture.[15] Due to this, aside from the bone reabsorption of alveolar after extraction, the necessity for using temporary prosthesis for a prolonged period may aggravate the problem.[9]

According to Carvalho and Okamoto[10] the process of alveolar repair after a tooth's extraction, aims to complete the bone tissue the space left in the socket.

Experimental studies about the evolution of the repair process show that it becomes complete in about 64 days in Homo sapiens.[31] Murray et al[28] reported that three conditions are necessary for the new bone's growth: The presence of scar tissue, preserved osteoblasts and contact with viable tissue.

A disruption of the original protocol proposed by Professor Willi Schulte, in 1978, recommending installation of the implant inside of the socket immediately after tooth's extraction in order to prevent alveolar bone reabsorption and in this way, increase the quantity of bone available for osseointegration. This would also lead to a better development of esthetic and functional implanted prosthesis.[22]

After extraction, the natural progression of the bone's reabsorption results generally in deficient crests, which can be problematical for the future implant's placement. The implant's installation in a fresh socket immediately after the tooth's extraction is considered a predictable and acceptable treatment.[19]

The placement of an implant immediately after tooth's extraction modifies the standard of new growth at the bone crest and favours the maintenance of the papilla and the contour of the gingival margin, optimizing the esthetic results of rehabilitation.[6]

The selection of candidates for immediate implant should be careful, because all depends on the condition of the adjacent tooth, reason for loss of teeth and the quality and quantity of bone tissue and of gingival epithelium.[7]

Peñarrocha et al[30] established a classification of the period between extraction and implantation, relating to the receiving area of implant therapy:

- Immediate Implantation: When the remaining bone is sufficient to ensure the primary stability of the implant, which is inserted immediately after the tooth's surgical extraction (immediate implants).

- Recent Implantation: When a time lapse between tooth's extraction and the implantation takes place. Normally between six and eight weeks, allowing enough time for scar tissue to form, thus allowing adequate coverage of gingival mucous of tooth's socket (Mediate Implants).

- Delayed Implantation: When the receiving area is not suitable for immediate implantation and requires therapy promotion of bone using guided bone regeneration (Delayed Implants), prior to implantation.

- Mature Implantation: When the lapse of time between the tooth's extraction and the implantation takes place over a period of over nine months (Mature Implants).

Indications

The main indication of this technique is the substitution of teeth with pathologies that do not allow treatment, including root fractures, root reabsorption, very extensive cavities, tooth's agenesis injury and cases where no apical endodontic treatment would be effective.[13]

Block and Kent[7] in their clinical experiences have established indications for implant placement immediately after tooth's extraction: Loss of teeth caused by trauma with low bone loss, teeth loss by carious processes without purulent secretion, impossibility of endodontic treatment, presence of severe bone loss without the presence of purulent secretions, minimum quantity of apical bone of 4 mm to obtain initial stability, health and appropriate quantity of the gingival epithelium to allow an occlusive patch.

Contraindications

The morphology of residual tooth's socket can complicate the adequate positioning of the implant. Axial Curves and lacerations root location of the apex of the tooth's socket are factors that must be examined prior and can sometimes even negate immediate implantation. In anterior teeth, for example, the insertion of the implant following the direction of the tooth's socket, the long axis of the implant will have a tendency to emerge in the vestibular region, in these cases; the angle for insertion of the implant should be directed towards the palatal region.[30]

Advantages

The immediate implants are installed inside the same socket as the surgical of tooth's extraction not requiring an incision for installation. This technique is called flapless surgery. In the case of installation of the immediate implant, the tooth is extracted only by the use of a periotome, without requiring incision or the exposure of the vestibular bone.[3]

Among the main advantages of this technique it is included the preservation of the gingival tissues and papilla in the esthetic zone, the installation of the implant in position and inclination similar to that of natural tooth and reduction of the surgical morbidity and a significant reduction in time and cost of treatment.[16]

This technique reduces the cost of treatment and preserves the height and width alveolar bone, facilitating the placement of the implant in relation to its length, width and angle. This is a great advantage compared to later implant, because it eliminates the healing period of the socket by reducing the surgical procedure time and thus decreases the time for the prosthesis installation[21].

The immediate implant installation also may be beneficial to the final esthetic result and making the prosthesis implant-supported, since the implant is installed immediately in the same place with inclination similar to the natural tooth.[24] Apparently the success of implants is similar to those of immediate implants installed in scarred bone ridge.[12]

Disadvantages

The disadvantages cited in recent scientific literature are the risk of gingival recession, the need for clinical experience in more complex cases of implant for the highest safety in immediate implant installation and the non-visualization of the alveolar bone which occurs, in the case, of small variances of drill bits employed and there may be vestibular bone fractures or perforations.[16]

Association with GBR

In the cases where one or more of the bone walls are lost, a dehiscence or fenestration may be formed after insertion of the immediate implant. These kinds of problems require more complex procedures with guide bone regeneration.[23] The technique is based on the hypothesis that the components of different cellular tissues show variable migration during the repair process.[28] For the correction of bone defects in immediate implant surgery, the autogenous bone promotes better results than do synthetic bone.[19]

Nowzari et al[29] studied the technique of guided bone regeneration in teeth with periodontal lesions all around of implants and concluded that when used in patients with periodontitis there is a great potential of failure due to infection.

In a recent systematic review of immediate implants it is reported that there is little definitive evidence about the effect of local infections on success and longevity of implants.[12]

There is no need for an integrity socket to promote osseous integration in the implants installed immediately after tooth's extraction. The use of membranes assists in bone formation. For this, it is essential that between the membrane and the exposed threads of the implant there is a space filled with a clot. If the membrane does not provide this space for the clot, there is need for filling material to maintain this space.[35]

Discussion

The rehabilitation of a lost tooth in the anterior-superior region is currently one of the main challenges in Implantology. The increased demand by patients causes the step before the implant installation critical to the role in both mechanical and functional aspects, as well as esthetic. So, the extraction followed by immediate installation of implants and immediate temporary prosthesis is a very viable option and is widely accepted.[17]

Atraumatic extractions are essential for the success of this type of therapy. The conditions of immediate implant installation are related to the etiology of tooth's extraction and, in this case, one should observe the following aspects: Morphology of the alveolar pre-extraction, quantity of remaining alveolar bone wal (independently of the alveolar bone quality), potential for chronic or acute infections at the site and primary stability > or = 35Ncm.[16]

The bone's reabsorption which occurs during the six months after the immediate implantation is the key point with which the professional is expected to work to maintain an esthetic structure peri-implant. In anterior teeth, in order to achieve an esthetic of emergence profile, the implants to be placed below the crest.[30]

It is known that in the region of the maxilla there is a 25% loss of bone volume in the first year and 40-60% of thickness up to the third year after tooth's extraction.[8] In the posterior alveolar bone region there is a loss of 50% during the same period.[26] Bone reabsorption can manifest itself in many aspects. In more severe cases it can lead to complete loss of osseointegration and therapy failure. In most common situations, there may be an esthetic problem, such as soft tissue changes, clinical crown lengthening and papillae disappearance and exposure of the metal band of prosthetic components. These are factors that can lead to esthetic failures. These are especially important in the anterior regions.[5]

Leonardo et al[24] compared the modification occurred *in situ* in the alveolar crest bone height around immediate implant and that induced of natural teeth, both prepared to support prosthetic devices situated on the cervical bone margin, without occlusal load. The results showed that in the peri-implant, initial re-absorption occurs in the bone crest, results in a remodeling process necessary to establish the biological space, as occurs with teeth that support crowns.

In rehabilitation of the anterior region, esthetics, especially the presence of papilla, must take into account the neighboring teeth. This is because in implants, in the same manner as in natural teeth, the presence or absence of papilla will depend on the interproximal bone crest height. Another important factor that also influences the preservation of papilla is the periodontal biotype, which is probably higher in patients with greater bone and gingival thickness giving a better chance of promoting the papilla.[20]

When the socket remains intact after tooth's extraction, with all its bone walls yet present, the implant can be installed immediately after of the extraction. Studies suggest implant placement 2-3 mm below the alveolar crest or apically at the level in the amelocementary line of the adjacent teeth when they are present.[4,18,22] It is necessary that the implant used is at least 3 mm greater than the root's apex of the recently extracted tooth in order to achieve a primary stability, so it is important there is no apical injury or infection.[21]

When installing implants in sockets after dental extraction the diameter of the implant does not match the exact diameter of the cavity, causing a space between the external surface of the implant body and the inner wall of the socket. This space may be filled with biomaterial, to prevent the epithelial migration into the socket and its interference in osseointegration of the implant, especially for promoting bone growth and thus allowing supporting tissue protection, maintaining the contour and gingival esthetic.[16]

Akimoto et al[1] in a study of dogs, concluded that even in areas of gap (initial space between bone and implant) of up to 1.4 mm there was after a period of 3 months of installation of the implants new bone formation with complete filling of the gaps. It is known that in faults of up to 2 mm spontaneous repair occurs and there is no need of filling the horizontal default (HD or gap). The distance between the trabecular bone remaining and the body of the implant can be up to 3 mm, as the clot itself ensures ossification. Up to 3 mm is necessary the use GBR techniques.[36]

Maksoud[25] demonstrated insertion of implants in the posterior region after atraumatic extraction of the respective tooth. A surgical technique that involves insertion of the implant in the interseptal bone socket, multi-rooted in the posterior region, which provides initial stability to the implant and partially fills the extraction site, was used. The author reports that the bone graft and the membrane are also required to fill the cavity and allow maximum bone formation around the implant.

Biomechanics are imperative to achieve clinical long-term success. The capacity of the implant loads depend on the quality of the bone-implant interface. Therefore, modifications to the design of the implant body and the surface enhances the availability of a larger surface area, thus contributing to increase the strength of bone-implant interface, more rapid bone growth, better initial stability of the implant and a more even stress distribution.[27]

The selection of the diameter of the implant is a decisive factor, because it allows adequate space for conformation of the gingival tissues, minimum distance to adjacent tooth structure and, especially, a correct emergence profile of the prosthetic crown. In a study where two small diameter implants were inserted immediately after extraction without opening flaps in the region of the maxillary lateral incisors, and crowns were installed then, Carvalho et al[11] obtained excellent results.

In a retrospective study of seven years, some authors found 95.3% survival in the small diameter implants. In this study, 192 implants with a diameter of 2.9 mm to 3.25 mm were inserted in areas with many disabilities or limitations of prosthetic space, of which 17 were in the region of the maxillary lateral incisors. However, the implants were placed according to the conventional two-stage protocol.[33]

In the immediate installation of the implant, two points are relevant: The drawing and the implant surface, which can directly influence the primary stability thereof. Cylindrical-tapered implants turn easier and ease locking of bone implants placed in sockets after dental extraction.[16]

The implants with internal connections characteristic to Cone Morse, provide an enhanced interface between the implant and abutment, causing a cold weld between these elements, non cracking and increased resistance to micromovements, providing a rigid connection. The Cone Morse system better distributes and supports the lateral forces of the external interface, and that of the internal hexagon.[2]

When, after the installation of implant the primary stability is achieved and the patient did not present any parafunctional habits (e.g. bruxism) one can install prosthesis, temporarily or permanently, even if the patient is edentulous, either partially or totally. Within 48 hours after the installation of the prosthesis, the Immediate Aesthetic Load differs from the absence of direct occlusal contact with the antagonistic teeth.[16]

In a study with a 16-year follow up of patients, the survival rate of implants placed immediately after tooth extraction was 96% and should therefore be a procedure of choice due to its excellent survivability.[34]

In the anterior maxilla, where the esthetic aspect is of fundamental relevance to the patient, the implants with immediate loading characteristics have become commonplace.[37]

Although some studies report a greater loss of crested bone implants with immediate loading, there are also countless others showing similar results in implants in which osseointegration occurred free of load.[14]

According Szmuckler-Moncler, premature application of load on the implant itself does not lead to the encapsulation of the implant by fibrous tissue, but a very critical factor would be excessive movement in the implant-bone interface during the healing period.[32]

Conclusion

With high rates of success, the immediate implant technique further enhances the framework of rehabilitative solutions for cases of tooth loss. The reduction in treatment time, reduction in the loss of bone reabsorption by residual socket and loss of important gingival aspects such as emergency profile and the interdental papillae, for example, are some advantages of this technique.

However, some clinical and X-ray results should be evaluated for the same applicability or contraindication of this technique: The amount of bone, which allows better positioning stability and quality of bone remaining to ensure the primary stability of the implant, the existing anatomy from the extraction site, which demonstrates the suitability or not in the use of biomaterials for the maintenance or bone formation; the socket should have the capacity to keep at least 70% of the clot for bone formation. The non-preservation of cortical and the large expansion iatrogenic of the tooth socket during extraction may negate the suitability of immediate implant placement.

Among the attributes required for the proper use of implants are the implant shape, in which case the profile is tapered due to the proximity of the shape of the socket and the surface treatment, which scientific proof demonstrates that the surfaced implants maintain greater contact with the bone surface, thus favouring the osseointegration. The immediate implant placement in a chronically infected or periapical lesion is not disallowed, if clinical procedures before and after surgery are carefully performed, such as antibiotic administration, meticulous cleaning and alveolar debridement before surgery.

The professional must be aware of the anatomical relationships of the residual socket structures are very important, such as the maxillary sinus, nasal cavity, the mental foramen, mandibular canal and submandibular fossa. Immediate insertion should reach a depth at least 3 mm beyond the alveolar apex to achieve primary stability.

It is important to recognize that the success of immediate implant therapy is associated with constant structuring of the criteria for optimization of esthetic and functional results and development of increasingly sophisticated implants. For all this to occur, scientific research and clinical practice should always and continuously be consulted.

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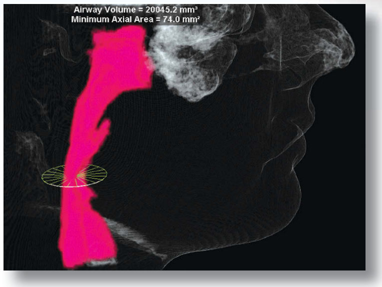

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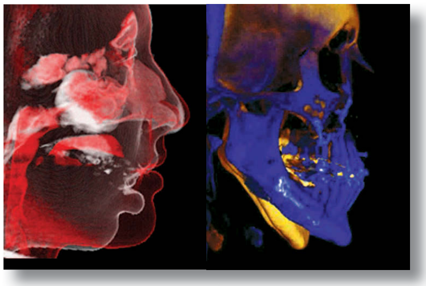

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Retention influence of crowns cemented on implants with and without screw access

Mirella Aguiar de **FREITAS***
Paulo Vicente **ROCHA****

Abstract

Introduction: In Implantology, the retention mechanism of the restoration to the intermediate can be cemented or screwed. The cemented one present difficult reversibility, however, the use of an access hole to the screw would allow such reversibility, combining the low cost of the components to the reversibility of the screwed prosthesis. **Objective:** The aim of this study is to evaluate the shear bond strength of prostheses on cemented implants, having or not access to the intermediate screw. **Methods:** Sixteen specimens were prepared (similar to regular implants, "Tiprep" intermediates (Bionnovation, São Paulo / SP) and 16 metal crowns, of which 8 were for conventional crowns control (G1) and another 8 crowns were made with an access hole to the screw, trespassing the metal, being the experimental group (G2). The crowns were cemented with RelyX U100 (3M ESPE) and the specimens from the G2 had the opening of the channel restored with light cured composite resin Filtek Supreme XT (3M ESPE). Specimens were subjected to tensile test in a universal testing machine 24 hours after cementation. **Results:** G1 showed average of 191.075 N; G2 showed 161.280 N. Applied the nonparametric Kolmogorov-Smirnov test, the dependent variable followed normal distribution ($p = 0.923$) and, with the Student t-test, there was no difference statistically significant ($p = 0.353$) between groups. It was considered the level of significance of 5%, $p = 0.05$. **Conclusions:** Based on the analysis, it can be stated that the access hole to the screw does not compromise or decrease the retention of crowns.

Keywords: Cement. Retention. Implant-supported dentures. Reversibility.

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Introduction

The use of oral implants provides a wide range of possibilities and elements to be used, which, if properly suggested and applied, allow resolutions which were considered unviable until some time ago. These situations comprise from a simple periodontal bone loss until more complicated situations from the maxillofacial system, such as tooth loss or major traumatic anatomical losses. Implantology has its own laws and elements that include sciences such as Biomechanics, Biomaterials, Histophysiology, Immunology and Molecular Biology, associating to clinical sciences as Prosthodontics, Surgery and Periodontics.

Osseointegration in the past two decades has revolutionized the prosthetic planning. Criteria such as anchoring, parallelism, surface area, prosthetic space height, esthetics, occlusal patterns and presence of parafunctions are essential in choosing the type of prosthesis system on implants to be recommended for patients.[1, 2]

The selection of the retention system of the prosthesis on implant must happen in the planning stage, before the surgical one, in order to determine the most suitable positioning for the implant.[3] It should be taken into consideration the biomechanical principles and esthetic to be reached.[4]

Among the various decisions to be made, there is the type of implant-prosthesis retention, if screwed or cemented. Many studies evaluate their advantages and disadvantages.[5] The screwed prosthesis have been used successfully in patients completely edentulous, due to the reversibility factor and greater convenience in extensive cases; therefore, is the first treatment option when the implant position permits, of the presence of cantilever and limited prosthetic spaces, among other situations.[1,5,6,7] However, in partial edentulism treatment, the restorative concept involving the use of cemented prostheses becomes the object of study and discussion.[8] This modality is, according to some authors,[2,4,9] the first treatment option when esthetics are prioritized, when the implants are poorly positioned and in cases of passivity in the settlement and uniform load transfer in prosthetic restoration and implant.

Screwed prosthesis have as greater advantage the reversibility and ease recovery and maintenance of restoration, allowing the removal of the prosthesis for crown repairs (ceramic fracture), the exchange of components due to loosening or fracture of the screw and a better assessment of oral hygiene and peri-implant probing.[1,2,3,6,8,9,10] Moreover, cementing implies the risk of having incomplete removal of cement, which can result in peri-implant inflammation, edema, ulceration, presence of exudate and bleeding to probing.[11]

In cases of reduced intermaxillary space, screwed prostheses are well indicated by not requiring them to great height to intermediates.[12] According to Misch,[4] the retention of these prostheses is more discreet, since there is no need for a vertical component of at least 5 mm in height to provide retention and resistance as the cemented prostheses.

Compared to screwed prosthesis, cemented prostheses have superior esthetics and occlusion, as well as passive settlement of the prosthetic structure.[1,4] Despite all these advantages, the difficulty of reversibility of the prosthesis and removal of cement excess remain as disadvantages.[1,5]

Occlusion is a noted factor in the selection of the restoration type. In posterior teeth, the implant should ideally be installed in the central fossa of the tooth to be made, so that the generated force is axial. In cemented prosthesis, the occlusal contacts are more stable due to the absence of the screw access channel, which takes a significant portion of the occlusal table. The contact in screwed prostheses is generally located in this area. The material that seals the channel, usually resinous composites, has a doubtful efficiency.[8]

As for esthetics, cemented restorations are more beneficial. The screw access channel is anti-esthetic, being this problem more prevalent in areas of lower premolars and molars. The opaque resin composites are used to minimize the gray level of the channel.[1,3,4,8]

The risk of absence of passivity of screwed prosthesis results in a large concentration of stress around implants compared to cemented ones.[13] The small misalignments of cemented prosthesis can be compensated by cementing, and they also help to ensure that the forces are transferred along the whole set prosthesis / implant/bone.[2,9]

The manufacture of cemented prosthesis is simpler and less expensive than the screwed prosthesis. Techniques are similar to traditional tooth-supported prosthesis, not needing further training of laboratory technicians, or use of more expensive components, such as the screwed. [5]

Zarone et al[2] in their study evaluated the fracture resistance of screwed metal-ceramic crowns compared to cemented. Statistical analysis indicated no significant difference between the two groups, despite the cemented prosthesis showing fracture resistance values higher than the screwed. Torrado et al,[14] following the same line of research, found that a significantly smaller force was required to fracture the screwed crowns compared to cemented, and that the location of the screw access channel of the intermediate to the implant within the occlusal table does not affect the fracture resistance of the ceramic.

The cemented prostheses have the possibility to repair the decreased restoration in cases of future failures, making their maintenance difficult at the office. [15] In case of needing to repair the intermediate, usually caused by the loosening of the screw, the restoration should probably be destroyed, because its removal is difficult and it often remains cemented, being necessary to make a new prosthesis. Any force applied to removal of the prosthesis has the potential of causing damage to the inner surface of the implant, or fracture of the fixation screw of the intermediate.[5, 16]

Emms et al[17] investigated the effect of filling and sealing screw access channel of the intermediates in the retention of cemented prostheses implant-supported when used the cement TempBond (temporary cement) for fixing the crown. Existing, clinically, the risk of loosening and with the intermediate having a good retention, the result of the study suggests that the complete obturation of the screw access channel, when cemented with TempBond, may be appropriate to promote the retention of the prosthesis.

To obtain some reversibility in cemented prostheses, some authors suggest the use of temporary cements in definitive restorations.[1,8,18] The use of definitive cements results in difficulty in maintaining the cemented prosthesis.[16]

Valbao et al[19] suggest the production, in the cemented crown, of an access channel to the intermediate in the central area of the lingual face with a carbide bur, the use of temporary cement and photopolymerizable resin to close the opening of the channel. An ultrasonic device or others for removal of prosthesis may be used without danger to the intermediate, since the resin has been removed. The disadvantage of this technique is that it can not be applied when there is limited interocclusal distance.

Doerr and Tucson[20] presented a method for locating the screw access channel of the intermediate to the implant, facilitating the removal of the cemented restoration without its destruction or the intermediate. The authors made a guide similar to the surgical guide, perforated in the region of screw chamber. On this perforation it was carried out a preparation with a diamond burr in the metalic or metal-ceramic prosthesis until reaching the screw. This technique has the disadvantage of requiring the use of the original model of cemented prosthesis.

Okamoto and Minagi[21] suggested a technique for reversibility of cemented implant-supported prosthesis using temporary cements. They made a cylindrical hole on the lingual surface of the intermediate (0.7 mm) and an access channel on the lingual surface of the prosthetic crown (1.5 mm) similar to a key/lock set. To remove this prosthesis, it is inserted a cylindrical guide in the same dimensions of holes ("removing driver"), generating a force, leading to the fracture the temporary cement line and allowing removal of the prosthesis. Rajan and Gunaseelan[9] described in their article a technique for making single cemented/ screwed implant-supported prosthesis, in which the crown (cemented to intermediate) has an access channel to the screw, serving as a device for intermediate's replacement. The prosthesis and the intermediate can be easily removed from the implant without the necessity of a crown-screw or destruction of them, facilitating also the residual cement excess cleaning. This technique may be contraindicated for patients with limited inter-occlusal distance.

Schwedhelm and Raigrodski[16] described a technique to facilitate the location of the access channel to the intermediate screw in cemented prostheses. The crown is manufactured in a conventional manner and prior to the glaze. The intermediate is placed on the plaster model and the angle and the opening of the channel are recorded. In the region of the access channel is applied a pigment (stain) on the ceramic, identifying it. With the subsequent need for removal of the intermediate a radiograph is taken to assess the angulation of the implant and the ceramic indicated by the pigment is removed. The channel is sealed with composite resin.

Uludag and Celik[22] described in their paper a method of fabrication of implant-cemented fixed prostheses, keeping the screw access channel to the intermediate without coating of metal and ceramic; a reversible cemented prosthesis. The screw can be easily achieved by the access channel prepared in the metal polishing stage. The restoration would then be removed without its destruction.

The present study aims to evaluate the influence of the access channel in the tensile strength of implant-cemented prostheses. It is observed that in literature there are no studies that examine the physical and mechanical properties of implant-cemented prostheses, having in its structure the screw access, incorporating the simplicity of cemented prostheses and reversibility of the screwed ones, which, if not implying in biomechanics quality loss, may be another important option in the construction of implant-supported prosthesis.

Material and Methods

Sixteen specimens were made, divided in two experimental groups.

The specimens had the following characteristics: regular implant analogs (Bionnovation, São Paulo / SP, code 09004), attached to the acrylic resin contained in a PVC pipe of 3 cm in height and 0.5-in in diameter.

Over the analog, the intermediate was screwed used for cemented prosthesis, straight, 2 mm in height and made of titanium, from the commercial brand Bionnovation, denominated "Tiprep" (Fig 1). Each intermediate was attached to analog with the torque of 35N.

The implant analog was positioned with the aid of a delineator so that it was perpendicular to the ground and the traction was performed axially to its long axis, avoiding this way the decomposition of forces (Fig 2).

16 metal crowns (Co-Cr) were made on these intermediates for implant-cemented prosthesis (Fig 3), and 8 of them were conventional, constituting the control group (G1). The other 8 crowns were made, however, with an screw access channel trespassing the metal, constituting the experimental group (G2) (Fig 4).

All specimens were cemented with universal self-adhesive resin cement RelyX U100 (3M ESPE) (Figs 5, 6 and 7), according to manufacturer instructions. Specimens from G2, with screw access, had it restored with light cured composite resin, Filtek Supreme XT (3M ESPE) (Fig 8).

The specimens were subjected to vertical tensile test in a universal testing machine (EMIC DL 2000) (Figs 9 and 10), 24h after cementation of crowns. A speed of 0.5 mm/minute was used, recording in Newtons the displacement of the crown. Data were pooled and analyzed statistically with the nonparametric Kolmogorov-Smirnov test and Student *t* test.

Results

The test results are presented in Tables 1 and 2, evaluating the minimum tensile strength for removal of implant-cemented prostheses.

Table 1 presents the data of the control group (G1) which obtained 191.075 N as the mean value of force to the displacement of the crown, minimum value of 92.71 N and maximum value of 266.20 N. In the experimental group (G2) the average strength was found 161.28 N, 89.23 N for minimum value and 248.86 N for maximum value (Tables 2 and 3).

Through the Kolmogorov-Smirnov test, the dependent variable follows a normal distribution ($p = 0.923$) (Table 4).

Applying the Student's *t* test it was compared the average of the control and experimental groups. Through the statistical test applied, it was found that there is no statistically significant difference ($p = 0.353$) between the control and experimental groups. It was considered the significance level of 5%, or p M 0.05 (Table 5).

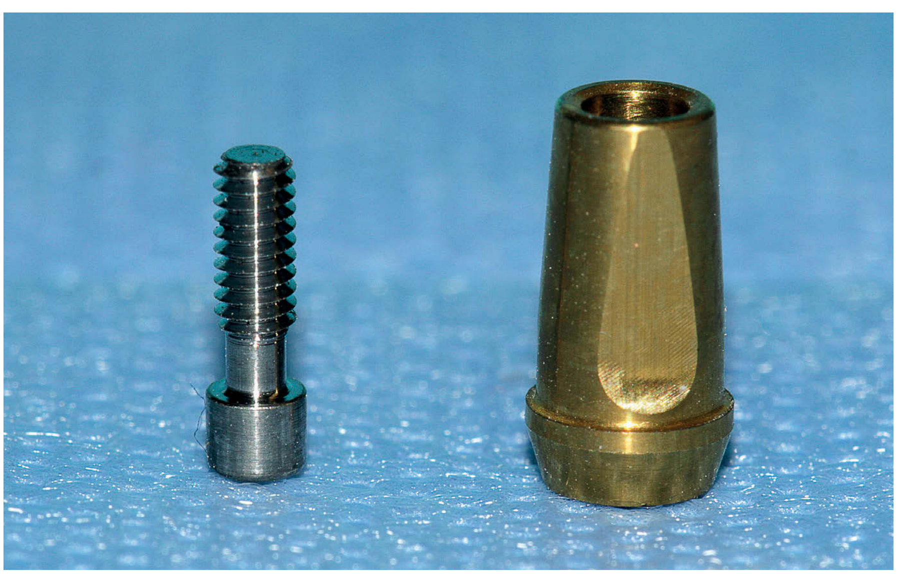

Figure 1 - EC RP 2.00 Pilar (Bionnovation).

Figure 2 - Implant analog positioned with the aid of a delineator in the PVC pipe.

Figure 3 - Full metal crowns for cemented prosthesis on implant.

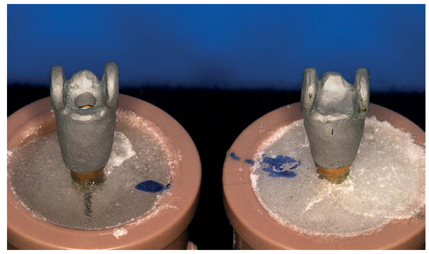

Figure 4 - Control group and experimental group.

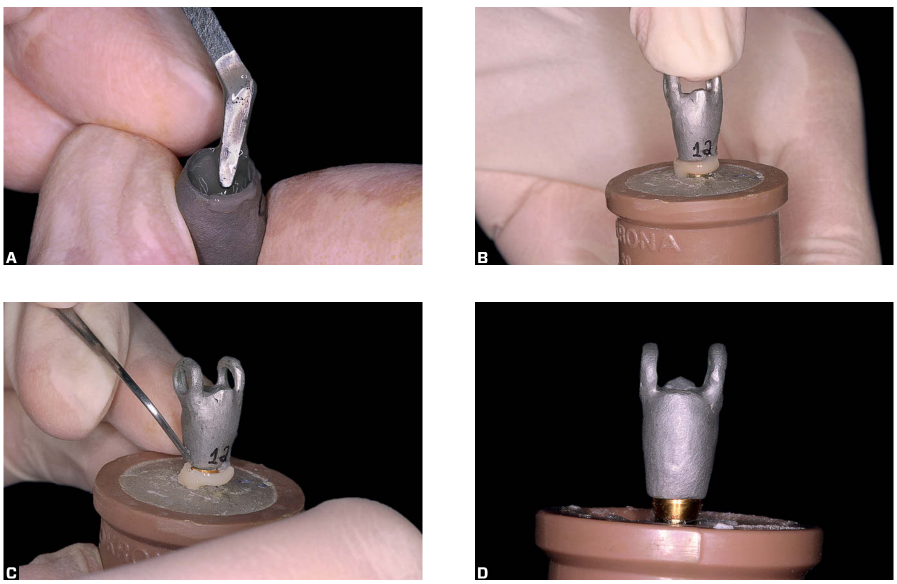

Figure 5 - Cementing of the specimens in the control group.

Figure 6 - RelyX U100 resin cement.

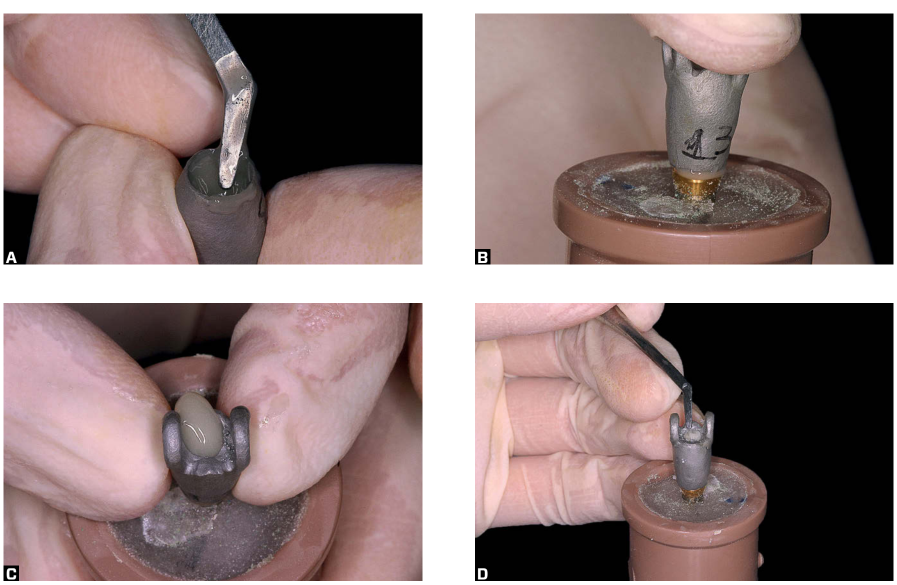

Figure 7 - Cementing of the specimens in the experimental group.

Figure 8 - Filtek Supreme XT (3M ESPE) Photopolymerizable composite resin.

Figure 9 - EMIC machine with the specimen positioned for testing.

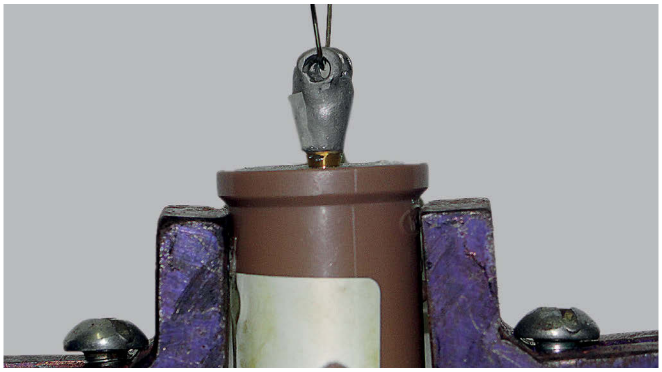

Figure 10 - Approximate view of the specimen positioned in the machine EMIC for testing.

Table 1 - Control group.

Test	Force (N)
Test 1	164.51
Test 2	135.23
Test 3	266.20
Test 4	142.20
Test 5	250.95
Test 6	221.67
Test 7	255.13
Test 8	92.71

Table 2 - Experimental group.

Test	Force (N)
Test 1	99.68
Test 2	122.69
Test 3	248.86
Test 4	159.63
Test 5	89.23
Test 6	145.69
Test 7	216.09
Test 8	208.43

Discussion

One of the major concerns with the implant-cemented prosthesis is about the challenge of restoring when there is loosening of the intermediate' screw. Several authors seek adding to cemented prostheses the feature of reversibility with the intention giving to dentists the option of removing them from their implants without total destruction.[9,16,19-22]

Doerr, Tucson;[20] Okamoto, Minagi;[21] Schwedhelm and Raigrodski[16] described techniques to facilitate the location of the access channel to the intermediate screw in cemented prostheses, such as the fabrication of a perforated guide in the region of the screw chamber, or ceramic pigmentation to identify the access area.

Rajan, Gunaseelan;[9] Uludag and Celik[22] have studies lines that corroborate the purpose of this article: The manufacturing of implant-cemented prosthesis with a access channel to the intermediate screw serving as device to replace it. This device, as verified in the results, does not promote shear-bond strength, with significantly lower values compared to conventional cemented prosthesis, offering a good treatment alternative.

Conclusion

The increase in reversibility to cemented prosthesis provides to the dentist the union of the advantages of

Table 3 - Distribution of cases for comparison group.

	Frequency	Percent	Valid Percent	Cumulative Percent
Control Group	8	50.0	50.0	50.0
Experimental Group	8	50.0	50.0	100.0
Total	16	100.0	100.0	

Table 4 - Statistical distribution of results (Kolmogorov-Smirnov test).

		Measure
N		16
Normal standards[a,b]	Mean	176.1812
	SD	61.8191
Extreme differences	Absolut	0.137
	Positive	0.137
	Negative	-0.137
Kolmogorov-Smirnov Z		0.549
Asymp. Sig. (2-tailed)		0.923

a = Normal distribution. b = Calculated from data.

Table 5 - Statistical Distribution of results (independent sample´s test).

GROUP	N	Mean	SD	Mean error
Control Group	8	191.0750	65.6361	23.2059
Experimental Group	8	161.2875	58.0864	20.5367

Group statistics.

		Levene test for equality of variances		*t* test for equality of means						
									95% Confidence Interval	
		F	Sig.	*t*	df	Sig. (2-tailed)	Mean dif.	Mean error dif.	Inferior	Superior
Measures	Equal variances assumed	0.597	0.453	0.961	14	0.353	29.7875	30.9882	-36.6755	96.2505
	Equal variances not assumed			0.961	13.796	0.353	29.7875	30.9882	-36.7678	96.3428

Independent sample´s test.

cemented and screwed prostheses on a single type of prosthetic rehabilitation. Based on the results, it can be stated that the construction of the screw access channel does not affect or decrease the retention of crowns. The shear-bond strength tests have allowed to observe that the force required for the displacement of conventional cemented prosthesis has no statistically significant difference relative to the other with screw access channel. It was also observed that there are few reported studies in literature on the tensile strength of cemented/screwed prosthesis, requiring thus more scientific works.

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Accidental implant displacement into maxillary sinus

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ABSTRACT

Introduction: The oral rehabilitation practice using dental implants have developed over the past thirty years. Like any technique, implant dentistry is subject to complications that often arise from professional inexperience, technical factors related to implant placement, the need for additional procedures and patient-related factors. Despite the large number of implants placed today, migration of an implant into the maxillary sinus is a rare complication. There are several techniques to correct it and it is up to the professional to choose the one that best suits the patient. **Objective:** This paper aims to report a case of accidental displacement of an implant into the maxillary sinus. **Conclusions:** Proper planning is the best tool to avoid such complications. It would be wise on the part of the dentist to constantly seek to improve their professional skills and knowledge in order to attain complete mastery of the theoretical and practical forms of prevention, as well as specific conducts and treatments.

Keywords: Dental Implants. Oral rehabilitation. Maxillary sinus.

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Introduction

Implant migration into the maxillary sinus is a rare complication associated with the placement of a dental implant in the posterior maxilla.[1] The maxillary sinus is located in the body of the maxillary bone, which is the largest of the paranasal sinuses. It exhibits the shape of a pyramid lying on its side, and its anatomical structure is limited by the lateral wall of the nasal cavity, orbital floor, alveolar process of the maxilla and zygomatic process of the maxilla.[2]

After a tooth extraction, resorption of the alveolar process occurs due to lack of the necessary stimulus to maintain bone quality and quantity. In the posterior maxilla, there occurs the resorption of the alveolar process as well as activation of the osteoclastic capacity of the periosteum adjacent to the sinus membrane. The result of this process is pneumatization of the maxillary sinus. In such cases, the distance between the alveolar crest and the floor of the maxillary sinus is rather decreased, limiting the placement of a bone implant due to the risk of accidental migration into the maxillary sinus.[3]

Among the factors causing migration of an implant into the sinus one could highlight surgeon inexperience, lack of primary stability, placement of a dental implant without first lifting the maxillary sinus (in cases where the sinuses are overly pneumatized), application of excessive force during implant insertion, presence of infection and, in some cases, the presence of osteoporosis or osteopenia.[1,4]

Although panoramic radiography is the diagnostic method of choice, and although the incidences of Waters and facial profile are also useful, computed tomography provides greater clarity and three-dimensional visualization, making it indispensable for proper evaluation and conduct towards the case.[5] The professional should bear in mind that any foreign body displaced into the maxillary sinus can move inside this anatomical structure, which may cause the location displayed in imaging tests to be different from that found during surgery.

In literature three basic types of treatment are found to address the issue of accidental migration of an implant into the sinus: 1) Removal of the implant from the sinus through endoscopic surgery, 2) Removal of the implant and bone graft during surgery, 3) Monitoring without surgical intervention.[2]

Since it was developed in 1890, the Caldwell-Luc procedure is recognized as an appropriate means of access to the maxillary sinus as it allows inspection, diagnosis and treatment of diseases that affect it. Thus, it is a major surgical technique used to remove implants from inside the maxillary sinus and place bone graft in that region.[2]

This article aims to report a clinical case in which an implant accidentally displaced into the maxillary sinus was surgically removed.

Case report

The 48-year-old male patient was referred by a dentist specializing in implant dentistry to the service of Oral and Maxillofacial Surgery and Traumatology of the Santo Antônio Hospital/Sister Dulce Social Work Association. He reported that a foreign body had accidentally been displaced into the maxillary sinus after implant surgery. His past history included placement of four implants in the maxillary region. Three months thereafter, the surgical site was reopened for placement of healing caps. It was at the time when an attempt was made to install the implant healing caps located in the posterior region of the left maxilla that the implant was displaced into the maxillary sinus.

During the interview, the patient did not report any systemic condition or disease. Physical examination revealed that the oral mucosa in the area reported had no clinical signs of inflammation or communication with the maxillary sinus.

Palpation of the maxillary sinus region showed no clinical signs of inflammation, despite the patient's report. Panoramic radiography and routine laboratory tests were then ordered. Panoramic radiography showed an image suggestive of a radiopaque metal instrument in the posterior aspect of the left maxillary sinus, compatible with an implant (Fig 1). Analysis of the case records led to the conclusion that it would be impossible to surgically remove the object by drilling, which had been tried previously.

Thus, surgery for removal of the object was planned and scheduled for 30 days after the accident. During this period the patient was monitored and there were no signs or symptoms of buccal-sinus communication or sinus inflammation.

In keeping with the surgical procedure, a linear incision was performed in the left maxillary region and a relaxant incision in the anterior region, which extended to the bottom of the sulcus. With the aid of retractors, the flap was raised along with the periosteum, exposing the lateroanterior wall of the maxillary sinus and the base of the zygomatic bone. An elliptical window was prepared with carbide bur n° 8 (Komet®, Besigheim, Germany) and a straight piece under copious irrigation with saline. The implant, located at the rear of the maxillary sinus, was removed through the opening with the aid of a hemostat (Figs 2 and 3). The site was then copiously irrigated with 0.9% saline and sutured with nylon 4.0 with the key purpose of repairing the mucous membrane.

The postoperative medication consisted of antibiotic (Amoxicillin 500 mg, Medley, SP) every 8 hours for ten days. Anti-inflammatory medication (100 mg Nisulid, Aché Laboratories, SP) was also prescribed every 12 hours as well as sufficient analgesics to control painful symptoms (Tylex 30 mg, Janssen-Cilag, SP). As an adjuvant in bacterial chemical control, the patient was instructed to perform mouthwash with chlorhexidine gluconate 0.12% (Colgate-Palmolive, SP) from the day after surgery until two weeks after surgery.

Figure 1 - Preoperative panoramic radiograph showing metal instrument in the region of the left maxillary sinus.

Suture removal was performed after seven days, and no major complications were noted during this period. Six months after implant removal a new panoramic radiograph was taken, and the displaced implant was no longer seen in the maxillary sinus. Furthermore, the other implants were found to be in their proper position as planned (Fig 4). Currently, the patient is scheduled by his implant dentist to undergo maxillary sinus grafting and placement of a new implant in the region, aimed at subsequent prosthetic rehabilitation.

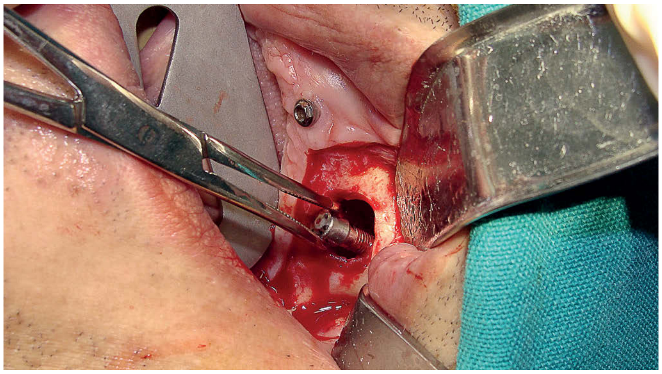

Figure 2 - Removal of implant from inside the maxillary sinus with the aid of a hemostat.

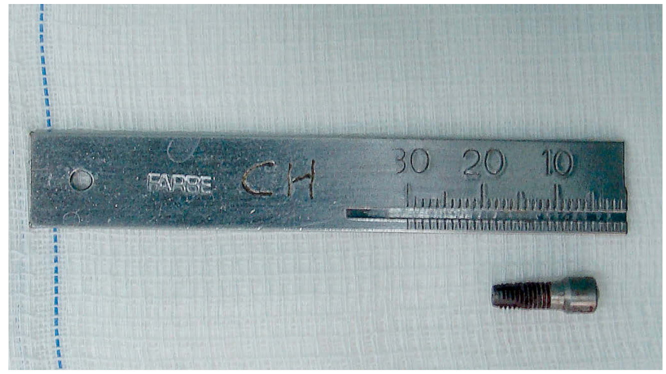

Figure 3 - Implant removed.

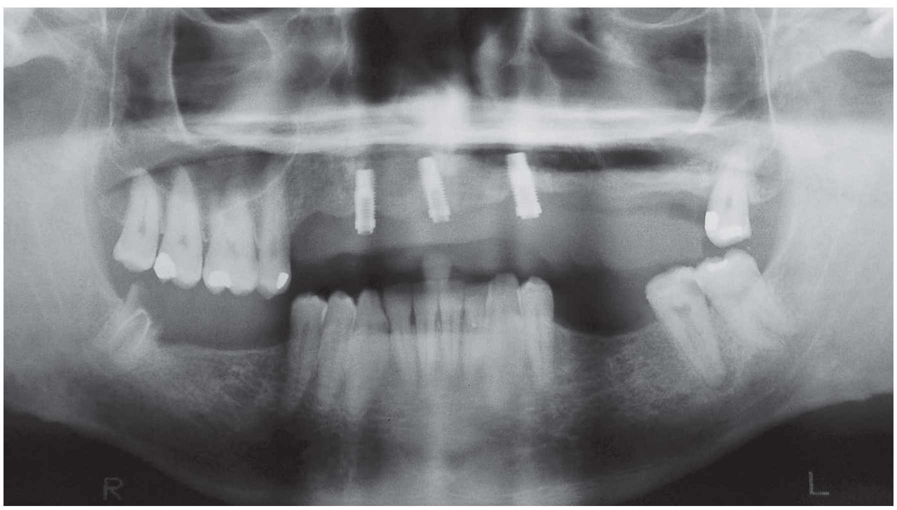

Figure 4 - Postoperative radiograph after 6 months showing implants placed in the anterior maxilla with no trace of the implant which had accidentally been displaced into the maxillary sinus.

Inclusion of this case in the present article was authorized by the patient, who signed a term of free and informed consent.

Discussion

The maxillary sinuses were first described in the seventeenth century by the English anatomist Nathaniel Highmore, and are therefore also called maxillary antrum or antrum of Highmore. Their shape and size vary according to factors such as facial type, color and number of teeth.[6] Maxillary sinuses are usually larger than other sinuses and are located primarily in the body of the maxilla.[2] These anatomical structures tend to encroach (pneumatization) on the spaces left by missing teeth, usually becoming quite developed in edentulous patients.[6] A few different iatrogenic cases of maxillary sinus perforation have been reported. Fractured roots of second molars are the most commonly found foreign bodies in the maxillary sinus. Drills, amalgam, gutta-percha, endodontic files and even periodontal curette tips are some of the dental products that have been found in maxillary sinuses.[3,5,7] With the advent of dental implants, this type of complication has also occurred during implant surgery in the posterior region of the maxilla,[3] such as in the case reported in this article.

Kluppelet et al[1] reported two cases of implant migration into the maxillary sinus. In the first, the patient returned for the second stage of surgery 6 months after implant placement for rehabilitation of edentulous spaces in the maxilla. At that time, it was noted that the implant that had been inserted in the region of the upper right first molar was missing. Radiography revealed that the implant had migrated into the maxillary sinus. Surgery was performed to remove the implant concurrently with maxillary sinus augmentation during surgery. In the second case, the patient complained about a missing dental implant in the alveolar ridge. Panoramic radiography and computed tomography revealed a dental implant displaced in the maxillary sinus roof, in close contact with the orbital floor. Surgery was proposed to remove the implant and in another surgical procedure the ridge was reconstructed with autogenous graft, enabling rehabilitation with an implant-supported denture.

Aguiar,[3] in 2007, reported an unusual case of displacement of a surveyor into the maxillary sinus during a dental implant surgery in the region of tooth #25. Caldwell-Luc operation was employed to remove the instrument.

Accidental displacement of fragments into the maxillary sinus can predispose to the appearance of maxillary sinusitis, characterized by severe, constant and localized pain, sensitivity in the teeth located near the infected sinus, nasal secretion – which can be mucopurulent - and breathlessness. Onset of changes in the antral lining can be delayed for months or even years. However, if the sinus is not infected, there is no need for curettage and removal of the sinus membrane.[2,6,8] The present case did not display any infectious changes in the maxillary sinus, probably owing to the short period that the implant remained within the sinus. Thus, sinusectomy was not performed.

Bodies displaced into the maxillary sinus can be anatomically located through occlusal or panoramic radiography, Waters techniques, and lateral skull radiography. Spotting the object, however, is not always straightforward given the overlap of anatomical structures. Thus, computed tomography provides greater accuracy than conventional radiography techniques.[6] More often than not, Morais[5] reported the use of panoramic radiography in these situations, associated with incidences of Waters and lateral cephalogram. He further reported the use of more complex tests such as CT and/or MRI. These methods are not justified in these cases as they do not contribute any additional information that might have a bearing on the diagnosis or therapy, while greatly burdening the patient and/or public service.

Foreign bodies can move within the sinus cavity. Therefore, imaging studies should preferably be conducted prior to surgery.[2] In the present case, panoramic radiography was used as a complementary imaging exam to pinpoint the exact location of the implant displaced into the sinus.

Recurrent chronic sinus diseases, tooth displacement or presence of foreign bodies inside the maxillary sinus are often reported in the literature as indications for surgical access by the Caldwell-Luc procedure.[5] This technique requires a U-shaped incision, also known as Wassmund incision. This technique can be performed starting with a linear incision on the mucosa of the buccal fornix.[6] Given that it is easy to handle, routinely used in surgery and provides proper visualization, this was the approach adopted for removal of the implant inside the maxillary sinus.

Endoscopic surgeries offer an alternative to the Caldwell-Luc procedure as an approach to the maxillary sinus. The technique is performed through an endoscope (an examination instrument which provides a wider field of vision and less exposure of the anterior wall of the maxillary sinus) allowing proper visualization of the surgical field, low morbidity and high patient acceptance. Nevertheless, given the fact that the technique is not so widespread in the dental area and that the logistical resources of both public and private services are deficient, the technique is not yet viable as a routine procedure.[3,5]

In this case, surgery was performed, but there is consensus that careful clinical evaluation combined with the dentist's common sense is a decisive factor in choosing the most appropriate therapeutic alternative for removal of foreign bodies from inside the maxillary sinus. It is important to assess the risks and benefits of each case, considering the possibility of nonsurgical follow-up.

Conclusions

Surgery to place implants in the posterior maxilla must be performed safely and with proper planning. Prior to surgery, it is essential to assess – by clinical and imaging examination – bone quantity and quality since maxillary sinus augmentation should always be an option in cases of severely pneumatized maxillary sinuses. When such precautions are not followed, problems may occur such as perforation of the maxillary sinus or an accidental displacement of instruments or implants into the maxillary sinus. These issues often require additional surgical procedures.

In light of the increasing demand for dental implants and the vast number of complications related to the displacement of foreign bodies into the maxillary sinus, surgeons are strongly advised to seek continued professional improvement to attain mastery over theoretical and practical forms of prevention, as well as conducts and treatments specific to the situation in question.

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Morfologic osteoconduction evaluation of Gen-Phos and Gen-Mix in rat calvaria

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Abstract

Introduction: the use of bone replacements in Dentistry has increased as a result of satisfactory and predictable clinical results, lower postoperative morbidity and affordable prices. The most common material used is still the inorganic bovine bone with osteoconductive properties. In the 1980's began the search for a synthetic material with osteoconductive results equal or superior to inorganic bovine bone. **Objective:** To compare histological and histometric property of osteoconductive bone compound (GenMix, Baumer) with phosphate beta-tricalcium (GenPhos, Baumer) implanted in critical size defects in rat calvaria. Results: It was observed 32.5% of new bone formation in the group of compound bone and 45.9% in the phosphate beta-tricalcium group. **Conclusions:** Along the time of microscopic observation of this work, one can state that the materials studied are not absorbable and that phosphate beta-tricalcium is more osteoconductive compared to the compound bone..

Keywords: Biocompatible materials. Bone regeneration. Bone transplant.

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Introduction

The use of biomaterials in Dentistry has been on the rise. The development of materials with adequate osteoconductive properties and diminished surgical trauma encourages the use of these materials. So far the best clinical and histological results are achieved with autogenous bone.[1,2] However, autogenous bone graft has the disadvantages of increased morbidity and not being readily available.[3-7]

In this context, the search for a material with properties similar or superior to those of autogenous bone is the subject of much research in Implant Dentistry. As of 1982 researchers have agreed that ideally a biomaterial should be biocompatible, radiopaque, osteogenic, readily available, hydrophilic and allow guided tissue regeneration, among other features.[8,9,10]

In the 1980's the search for synthetic materials led to the introduction of calcium phosphate ceramics, which is particularly biocompatible and shows no adverse reactions. More recently, it has been associated with beta-tricalcium phosphate (β-TCP).[11] Commercially, these features can be found in BoneCeramic (Straumann, Basel, Switzerland) with a ratio of 6:4 β-TCP / hydroxyapatite, and GenPhos (Baumer SA, Mogi Mirim, Brazil), available in particles (0.5 mm to 0.75 mm) at a ratio of 7:3 hydroxyapatite / β-TCP. Theoretically, this is an osteoconductive material which acts as a scaffold for new bone formation due to the presence of hydroxyapatite, while degrading TCP, thereby enabling replacement by new bone. It is common knowledge that hydroxyapatite features very wide applicability in the medical field as well as in dental care for the filling of cavities.[12,13] It should be recalled that in terms of origin it can be either natural or synthetic, whereas its biological behavior is directly related to its physicochemical characteristics.

On the other hand, composite bone (organic and inorganic portions) (GenMix, Baumer SA, Mogi Mirim, Brazil) was developed with the purpose of reducing the amount of remaining material and inducing new bone formation, since inorganic bone (natural hydroxyapatite) features as its main disadvantage the presence of particles in the recipient site for longer than 24 months.[5,14,15]

This study aimed to assess composite bone graft (GenMix, Baumer SA) and β-Tricalcium Phosphate (GenPhos, Baumer SA) as osteoconductive materials in rat calvarial critical size defects performed by microscopic and histometric evaluation.

Material and methods

This study was approved by the Ethics Committee of the School of Dentistry of Bauru (USP) (Procotol 033/2009). The 18 Wistar rats (*Rattus norvegicus albinus*) used in this study were supplied by the laboratory of animal facility of the São Paulo State University (UNESP) in the Brazilian city of Araçatuba and were randomly divided into three equal groups which comprised the study sample. The rats were kept in individual cages and fed *ad libitum* throughout the experimental period except on the surgery day.

After fasting for 12 hours, the animals were intramuscularly anesthetized with a mixture of 2% xylazine and 5% ketamine hydrochloride in a 1:1 ratio at a dose of 0.2 ml per 100 g body weight.

After anesthesia, the region of the calvaria was shaved, the animal was placed in prone position, antisepsis with topic PVP was performed in the area (Fig 1) and sterile drapes were placed.

Next, surgical access was performed by means of an incision in the midline of the occipital protuberance as far as the eyes. The entire flap was folded back and retractors used to expose the parietal bone from both sides. Osteotomy was performed in the median region between the parietal bones as far as the inner cortex (Fig 1) using a trephine drill (7 mm) and with the aid of a low speed motor. Once osteotomized the parietal bone was removed and the dura mater kept intact (Fig 1).

In Group I the critical size bone defect was filled with particulate composite bone (GenMix, Baumer SA), homogenized in the blood of the animal and covered with a cortical bovine bone membrane (GenDerm, Baumer SA) trimmed into a circle to ensure a better fit (Fig 1) and subsequently a simple suture of the skin tissue was carried out with 5-0 nylon.

Likewise, Group II was filled with β-TCP particles (GenPhos, Baumer SA) homogenized in blood and covered with the same membrane used in Group I. In Group III, the control group, the critical defect was filled with blood clot and lined with a cortical bovine bone membrane (GenDerm, Baumer SA).

After 60 days the animals were euthanized by anesthetic overdose, and subsequently the parietal bone was removed with a 3 mm margin and fixed in buffered neutral formalin at 10%. The pieces were then demineralized and processed by semi-serial coronal sections (10 sections per piece) and stained with hematoxylin-eosin, which allowed microscopic and histometric analysis by Merz grid.[15,16]

Merz grid consists of a camera lens or photographic objective with 10 horizontal and 10 equidistant points on each line totaling 100 points. The technique of histometry consists in counting manually the structures on each point along the length of the blade. Subsequently, one obtains the sum of these measurements on the blade and in all sections of each piece, which ultimately yield the percentage of each structure in the piece.[15,16]

Microscopic analysis results

The control group showed that at the site of the critical bone defect new fibrous connective tissue was formed with collagen bundles parallel to the skull surface (Fig 2). This tissue was formed instead of new bone as the neighboring

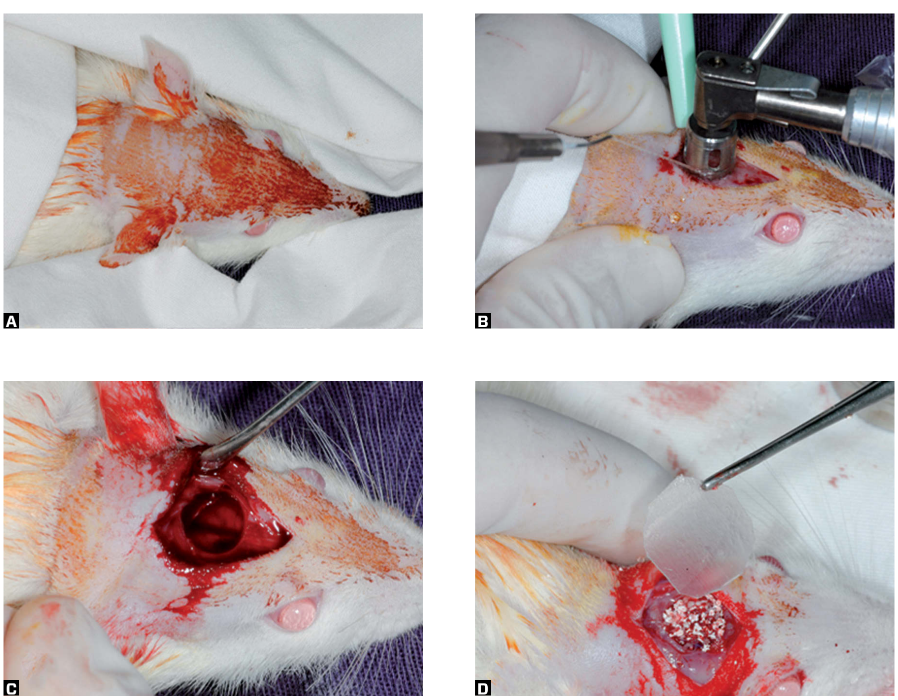

Figure 1 - **A**) Trichotomy and antisepsis with PVPI; **B**) Drilling with 8 mm trephine; **C**) Bone defect of critical size; **D**) Filling of cavity with biomaterial and placement of GenDerm membrane (Baumer SA).

bone cells were unable to move to the large surgically induced defect. A small formation of new bone was noted only on the margins of the defect (Fig 3). In the periods studied no inflammatory infiltrate was observed (Fig 4).

In Group II, most of the critical size surgical defect was occupied by the material's particles (Fig 5). Connective tissue was found amid these particles, which showed predominantly mononuclear inflammatory infiltrate and macrophages with granuloma formation of the foreign body type, directly related to most of the material's surface. The inflammatory multinucleated giant cells and macrophages that comprise these granulomas — as well as the connective tissues — were morphometrically affected by the demineralization process used. It is noteworthy that a portion of the surfaces of the particles of the material which is not in contact with the foreign body granuloma, is in contact with the newly formed bone as shown in Figures 5-8. No infiltration of neutrophils was found in the specimens examined, indicating the absence of bacterial contamination. Newly formed bone is predominantly associated with the particles located more internally in the surgical defect, i.e., the inner layers facing the brain, probably influenced by a greater stability of the particles.

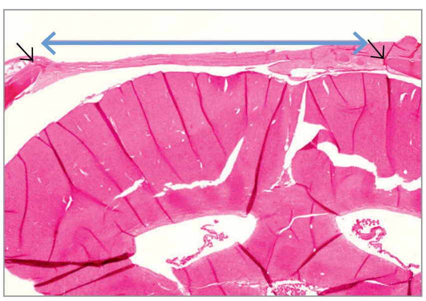

Figure 2 - Photomicrograph of control group showing critical size defects with no bone fill. Black arrows: Margin of bone defect. Blue arrow: Extension of bone defect.

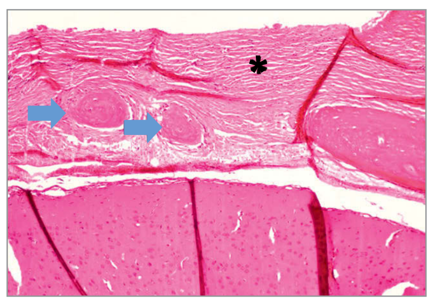

Figure 3 - Photomicrograph showing maximized fibrous connective tissue (*) and outline of bone formation near margin of defect (arrows).

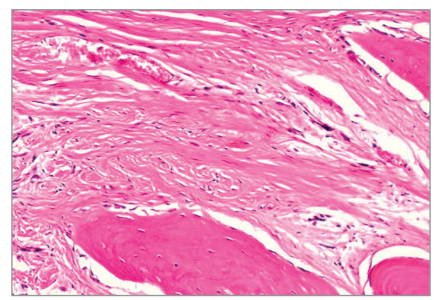

Figure 4 - Photomicrograph showing detail of connective tissue and no inflammatory infiltrate.

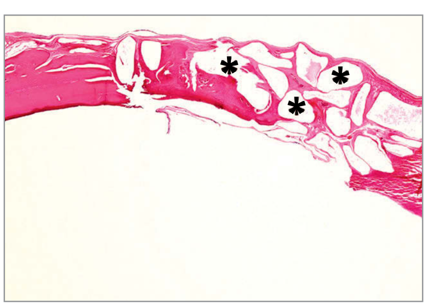

Figure 5 - Photomicrograph showing bone defect filled with GenPhos (*). Space occupied by GenPhos particles.

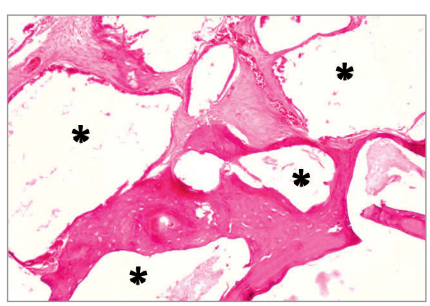

Figure 6 - Zoomed area shows GenPhos (*) particles in contact with connective tissue and with newly formed bone.

Figure 7 - Zoomed area shows GenPhos (*) particles in contact with connective tissue.

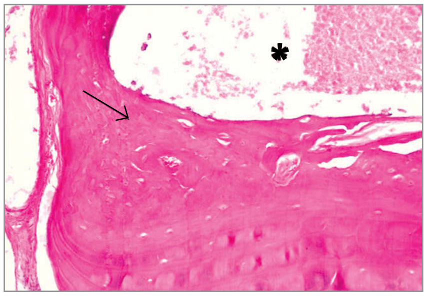

Figure 8 - Zoomed area shows GenPhos (*) particle in contact with newly formed bone (arrow).

Figure 9 - Photomicrograph showing bone defect filled with GenMix. (*) Space occupied by GenMix particles.

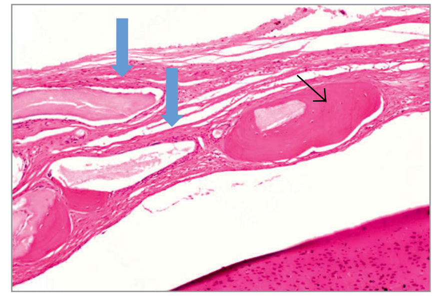

Figure 10 - Zoomed area shows GenMix particle surrounded by connective tissue (blue arrows) and by newly formed bone (black arrow).

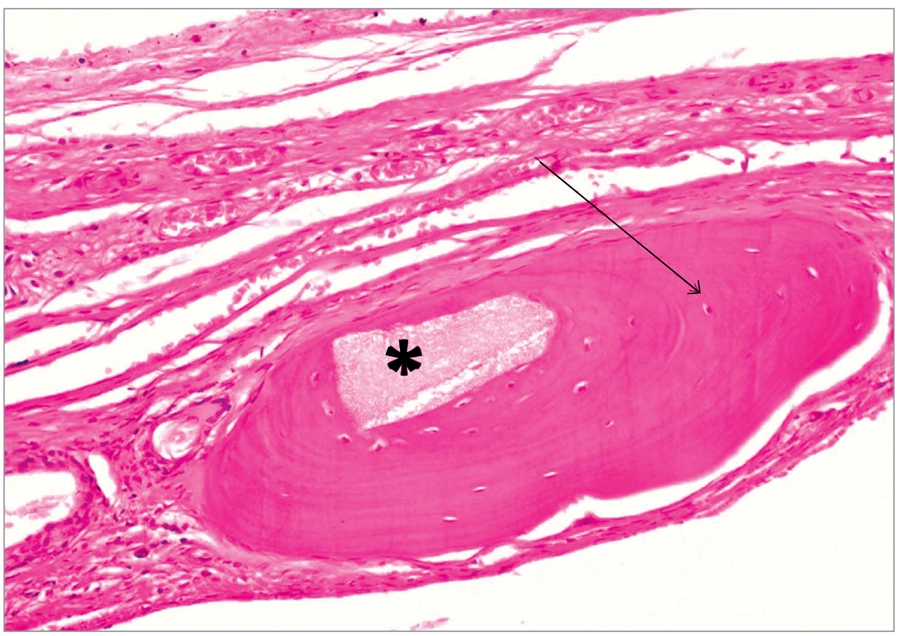

Figure 11 - The detail shows GenMix (*) particle surrounded by newly formed bone (arrow).

Table 1 - Connective tissue.

	Connective tissue	Newly formed bone tissue	Remaining material
Control	78.5%	21.5%	
Group 1	38.5%	32.5%	29%
Group 2	10%	45.9%	44.1%

Likewise, in Group I, most of the surgical defect was occupied by the material and its particles implanted at the site. Many particles of the material displayed part of their surface in direct relation to the newly formed bone and bone cell colonization. The other portion of the particle surfaces — which was also the largest — interfaced with the foreign body granulomas comprised of macrophages and inflammatory multinucleated giant cells. The morphological interaction with osteoblast cells can be clearly perceived (Figs 9-11) since the tissue components were very well stained and different from one another, which did not occur in Group II, probably due to technical problems. New bone formation around the particles — which was also found in this group — is more closely linked to those located more internally and closer to the brain. There is no infiltration of neutrophils in the specimens examined indicating the absence of bacterial contamination.

That these findings differ from the control group is quite evident, since morphologically new bone formation was found in the critical size surgical defects in both materials.

Histometric analysis results

By superimposing the Merz grid, histometry of the histological sections was performed taking into account in each group the presence of connective tissue, newly formed bone tissue and remaining material. Percentage means of the results are shown in Table 1.

By using the t-test to compare the amount of newly formed bone, connective tissue and remaining material between the groups, a statistically significant difference was found in the remaining material of Groups I and II ($p=0.007$), and in the amount of connective tissue between Groups I and II ($p=0.002$). There was no statistically significant difference in the amount of new bone formation between Groups I and II ($p=0.066$). When Groups I and II were compared with the control group, statistically significant differences were found in terms of connective tissue and in bone formation in Group II. New bone formation in Group I compared with the control group was not statistically significant.

Discussion

Control group results revealed that the size of the bone defect used in this study is indeed a critical size defect as it exhibits new collagenized connective tissue formation and no bone formation in its interior.

As described in the results, Groups I and II were similar with respect to cellular phenomena and new bone formation occurred amid a large amount of remaining material, which clearly showed the osteoconductive potential of GenMix and GenPhos, thereby corroborating the literature.[17-23] Histometric evaluation, however, disclosed a more effective osteoconductiveness in Group II, perhaps due to (1) inorganic characteristics of ceramics, (2) Resorption of β-TCP, and (3) presence of a greater amount of biomaterial after 60 days in the bone defect area (44.1% in Group II and 29% in Group I).

This outcome reflects an interesting clinical applicability. It is a well known fact that in lifting the maxillary sinus with autogenous bone or organic bone substitutes graft material is "resorbed," thus reducing the height of newly formed bone. The presence of remaining material for a longer period than the autogenous bone or organic bone substitute can reduce this "resorption," allowing the placement of greater length implants in the region of the sinus graft, which might theoretically increase the success rate of the implants.[24,25]

The stability of bone resorption in maxillary sinus lifting occurs after 2 or 3 years when a 2:1 ratio of autogenous bone to inorganic xenogenic bone is used.[24]

Other authors have compared the resorption of bone graft in maxillary sinus lifting with deproteinized xenogenic bone, xenogenic inorganic bone and porous hydroxyapatite and reported a higher resorption with xenogenic inorganic bone, concluding by suggesting that the latter be mixed with synthetic materials to reduce the resorption of newly formed bone.[26]

Another study evaluated the success rate of implants in the posterior maxilla with and without maxillary sinus lifting using β-TCP. In this study, the authors reported the failure of one implant in each group prior to the prosthetic phase (more than 99% success) and concluded that β-TCP can be used for implant placement.[27]

Histomorphometrically, in comparing TCP with autogenous bone in maxillary sinus lifting, nearly 32% consisted of new bone formation with no statistical difference between the groups. Furthermore, the amount of connective tissue was similar and bone marrow formation was higher in the autogenous bone group.[28]

Cellular phenomena during bone formation with synthetic materials are not well defined. Some authors have reported that the biomaterial particles appeared surrounded by connective tissue,[4,18,29] as shown in Figures 6 and 10. Others have reported finding bone on the surface of the particles (Figs 8 and 11).[19-23] However, this difference in the description of cellular phenomena is due to the type of animal used in the experiment and the assessment time. A study in dogs revealed the presence of particles surrounded by connective tissue within 4 weeks, and 28 weeks later the presence of particles surrounded by newly formed bone as well as the presence of foreign body type granulomas in earlier periods.[30] These findings corroborate the results of this study in rats and provide a similar description of the changes in cell population.

It is therefore obvious from the study results that these materials can be used for reconstructing bone defects for subsequent rehabilitation with osseointegrated implants.

Conclusions

This study has led to the conclusion that the tested materials in the experiment feature osteoconductive properties and can be used clinically for filling cavities. A significant difference was found between the use of these materials and the control group, which was filled with blood clots.

Further investigation is warranted to measure the amount of remaining material left by these materials, the amount of new bone formation and bone resorption in the long term.

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Dental agenesis treated with SLActive implant: Case report

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Abstract
Dental agenesis is a genetic abnormality characterized by total absence of one or more teeth. It affects about 6% of the population, affects preferably the second mandibular premolar and represents a challenge for rehabilitation because it leads to functional and esthetic problems. Currently, dental implants play a prominent role in rehabilitation, and the SLActive® implants stand out because they accelerate osseointegration, shorten it to 21 days, and ensure better quality of new bone around the implant. With high rates of success even when immediate or early loading is used, these implants have revolutionized modern Implantology. This report describes a case of dental agenesis of the second mandibular premolar treated using a SLActive® implant and a final prosthetic crown installed on the fifth postoperative week.

Keywords: Implant surface. Osseointegration. SLA modified surface.

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Introduction

Dental agenesis, the congenital absence of one or more teeth,[1] has a prevalence of 2% to 10% in the permanent dentition[2] and affects 6.3% of the Brazilian population.[1] Except for the third molar, the second mandibular premolar is the most often missing tooth (21%).[3]

The congenital absence of one or more teeth in the permanent dentition generates functional and aesthetic disorders, and rehabilitation by replacement of the missing tooth is necessary. Among rehabilitation options, the fixed-implant supported prostheses hold a prominent place. Dental implants with treated surfaces are used to ensure better implant-bone contact, higher quality of bone formation and faster osseointegration.

Currently, highly hydrophilic and energized surfaces promote osseointegration and have high indices of bone-implant contact[4] at short postoperative times (2 to 4 weeks)[5] and success rates between 98.2%[6] and 97.7%,[7] even when loaded within 21 days of implantation.

This report describes a case of agenesis of the second mandibular premolar treated using a SLActive® surface implant and a final prosthetic crown installed on the fifth postoperative week.

Case report

A 27-year-old white woman presented with a complaint of presence of a deciduous tooth in the right mandibular posterior region. Clinical (Fig 1) and radiographic (Fig 2) examinations showed that the mandibular deciduous second molar was present in the dental arch with no mobility, with gingival recession in the region of the mesial root, which was reabsorbed and surrounded by a translucent area of undefined limits, and with no permanent successor.

We chose to remove the deciduous tooth and install a SLActive® implant immediately. The extraction occurred after anesthesia by regional block of alveolar inferior, buccal and lingual nerves with injection of 1.8 ml of 4% articaine hydrochloride with 1:100,000 epinephrine, after which a sulcus incision was performed with a 15c blade to ensure conservative and minimally traumatic gingival detachment. The deciduous tooth was extracted using a 304 apical extractor. After tooth extraction, curettage was performed on the surface of the dental alveolus, especially in the mesial root area.

A Straumann SLActive® SP RN 4.1 x 10 (Figs 3 and 4) was implanted immediately after tooth extraction, following the sequence of drills recommended by the manufacturer. The gingiva was sutured with 4-0 Vicryl. The insertion torque was 35 N/cm.

The patient received 100 mg nimesulide and 1 g amoxicillin, both orally, one hour before the procedure; 200 mg nimesulide per day was administered for three days postoperatively.

The suture was removed on the 10th postoperative day; on the 21st day, the 1.5 mm cover screw was replaced with a 3 mm high healing screw (Fig 5). On the 30th postoperative day, molding procedures and crown manufacture (Figs 6 and 7) began. After the plaster model was ready (Fig 8), the manufacture of the final prosthesis began (Fig 9).

Five weeks after implantation, the final metal and ceramic crown were screwed to the 1.5 mm high SynOcta abutment (Figs 10 and 11). There were no painful symptoms after installation of the implant or during prosthetic procedures. The patient has been under clinical and radiographic follow-up for 3 years (Figs 12 and 13).

Figure 1 - Clinical aspect of deciduous tooth.

Figure 2 - Radiographic appearance of deciduous tooth and underlying bone.

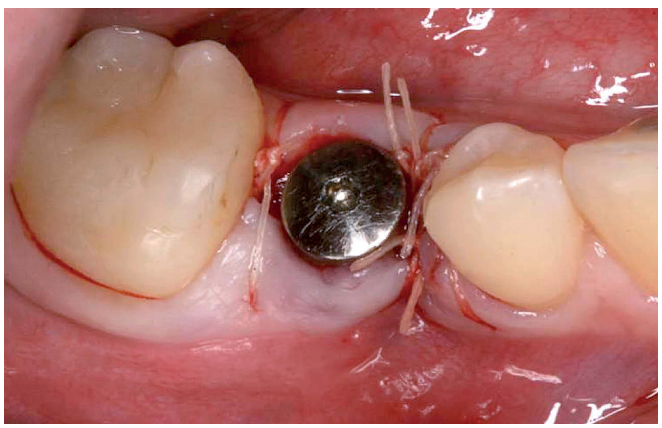

Figure 3 - Dental implant in position. Photograph shows 1.5 mm high cover screw and sutures after deciduous tooth removal and implant installation.

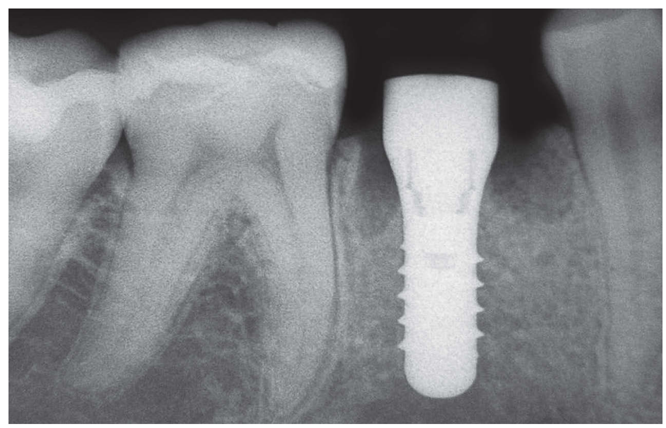

Figure 4 - Postoperative radiograph shows implant installed immediately after extraction of deciduous teeth.

Figure 5 - Clinical aspect after 30th postoperative day with 3 mm high healing screw.

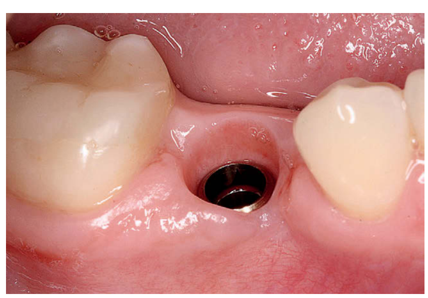

Figure 6 - Clinical aspect after 30 implantation days showing implant platform without 3 mm high healing screw.

Figure 7 - “Snap-on” impression component installed.

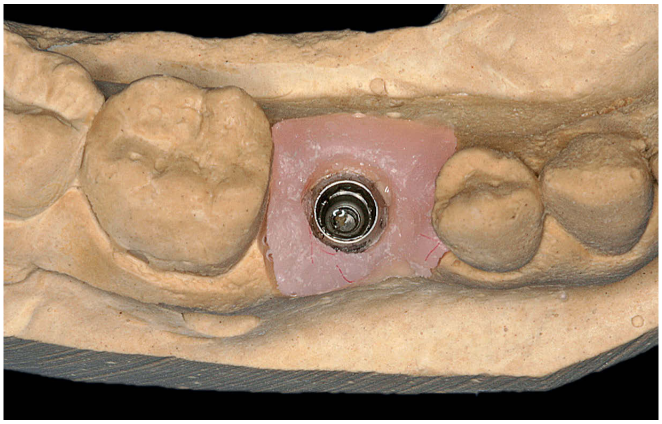

Figure 8 - Occlusal view of partial gypsum model.

Figure 9 - Final metal and ceramic crown.

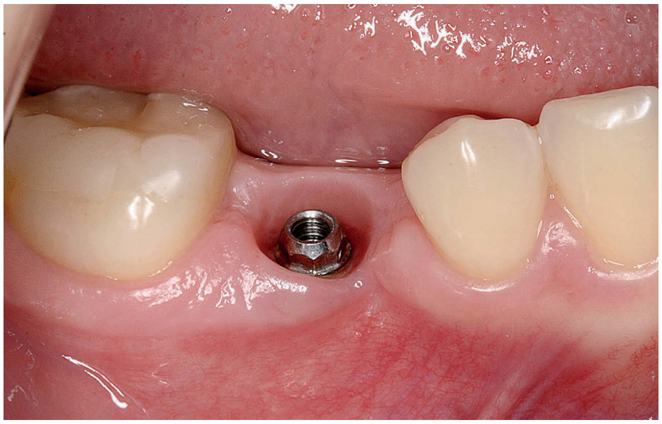

Figure 10 - SynOcta abutment of 1.5 mm high screwed to SLActive® implant.

Figure 11 - Final metal and ceramic crown screwed to 1.5 mm high SynOcta abutment (five weeks).

Figure 12 - Clinical aspect at three years' follow-up.

Figure 13 - Radiographic appearance at three years' follow-up.

Discussion

According to Pannu et al[2] dental agenesis is one of the most common genetic abnormalities among human beings. It occurs in 6.3% of the Brazilian population[1] and affects preferably the second mandibular premolar.[3] The case reported here properly fits this context.

The total absence of a tooth (especially a permanent tooth) is an esthetic and functional difficulty for the individual with such anomaly. The restoration of the missing tooth — or teeth — using a dental implant has become a consolidated treatment method in modern dentistry. Excellent clinical outcomes and major changes in the initial concepts, recommended by Adell et al[8] and Schroeder, Pohler and Sutter,[9] have corroborated this consolidation.

Technological advances, especially in dental implant surfaces have contributed to the achievement of higher success rates. In this context, we draw attention to the SLActive® surface, which has the same surface topography as the SLA,[10] but differs from it as it is wrapped under a nitrogen atmosphere and stored in a sodium chloride isotonic solution. Such procedure changes its molecular features so that it becomes highly energized and hydrophilic. Therefore, it potentially attracts and facilitates the contact of blood cells and molecules, and thus promotes faster[11] and better[12] osseointegration. High levels of success are achieved when implants are subjected to loads after 21 days of implantation,[10] or even when immediate loads are applied over poor quality bone (posterior area of mandible or maxilla).[13]

In the case reported here, we chose the SLActive® surface because of the factors mentioned above, which would ensure faster and better osseointegration and reduce the risk of implant loss and the discomfort of the deciduous tooth absence. We opted for this surface because of the minimum bone loss associated with it, even in longer follow-up times and short implants.[14] The clinical and radiographic features at 3 years' follow-up (Figs 12 and 13) confirmed the successful results, as bone is seen in the cervical region of the implant, in contrast with the radiographs taken immediately after the implant (Fig 4). These findings, moreover, are associated with little or no cervical bone loss.

Our report shows that technological advances in implant surfaces are relevant for the development of Implantology, and that the SLActive® surface has an innovative concept of quality, with good results even under adverse conditions and shorter times to achieve osseointegration and patient rehabilitation.

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Abstracts of articles published in important Implantology, Prosthodontics and Periodontics journals from around the world

Dario Augusto Oliveira **MIRANDA***

Immediate, early, and late implant placement in first-molar sites: A retrospective case series

Annibali S, Bignozzi I, Iacovazzi L, La Monaca G, Cristalli MP. Int J Oral Maxillofac Implants. 2011 Sept-Oct;26(5):1108-22.

Purpose: To review the clinical outcomes of immediate, early, and conventional single-tooth implant placement in mandibular or maxillary first molar sites. **Materials and Methods:** The charts of patients treated consecutively for first molar replacement according to unconventional (immediate = group 1, early = group 2) or conventional (late = group 3) surgical protocols were examined. All available clinical parameters were reviewed to calculate implant survival and success rates according to well-established criteria. Periapical radiographs obtained upon delivery of the definitive crown (T_2) and 1 year later (T_3) were digitized and assessed to evaluate marginal bone loss (MBL). Clinical photographs were evaluated to determine soft tissue health. **Results:** Forty-seven patients were treated with a total of 53 immediate, early, or late single implants. The last follow-up examination was at 38.84 ± 16.14 months (mean ± SD) for group 1, 32.91 ± 18.49 months for group 2, and 42.66 ± 12.41 months for group 3. The implant survival rate was 100% for all groups. The success rates were 91.7% for early implants, 95.0% for immediate postextraction implants, and 100% for implants placed in healed sites. MBL and soft tissue parameters did not differ significantly among the three groups at definitive restoration delivery or 1 year later; a thin gingival biotype, irrespective of treatment timing, was the only covariate that was able to slightly affect the outcome variables. Conclusions: Short-term implant survival and success rates, as well as MBL values for immediate, early, and conventional implants, appear similar for maxillary and mandibular first molar sites. Early placement should be considered as a suitable alternative to immediate placement when unfavorable conditions at the time of extraction could affect the clinical outcome of immediate placement.

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Failure rates of short (≤ 10 mm) dental implants and factors influencing their failure: A systematic review

Sun HL, Huang C, Wu YR, Shi B. Int J Oral Maxillofac Implants. 2011 July-Aug;26(4):816-25.

Purpose: The aim of this study was to evaluate the long-term failure rates of short dental implants (≤ 10 mm) and to analyze the influence of various factors on implant failure. **Materials and Methods:** The PubMed and Cochrane Library databases were consulted for follow-up studies published between the years 1980 and 2009. For those studies that met the inclusion and exclusion criteria, data concerning the number of implants (≤ 10 mm) placed and lost and any related risk factors were gathered in tables and subjected to analysis. Univariate and multivariate analyses were performed. **Results:** The heterogeneity and low quality of the included studies made meta-analysis impossible. A total of 35 human studies fulfilled the criteria. The studies included 14,722 implants, of which 659 failed. The total failure rate was 4.5%. The failure rates of implants with lengths of 6, 7, 7.5, 8, 8.5, 9, and 10 mm were 4.1%, 5.9%, 0%, 2.5%, 3.2%, 0.6%, and 6.5%, respectively. A majority (57.9%) of failures occurred before prosthesis connection. There was no statistically significant difference between the failure rates of short dental implants and standard implants or between those placed in a single stage and those placed in two stages (multivariate analysis). There was a tendency toward higher failure rates for the maxilla and for dental implants with a machined surface compared with the mandible and dental implants with a rough surface, respectively. **Conclusions:** Among the risk factors examined, most failures of short implants can be attributed to poor bone quality in the maxilla and a machined surface. Although short implants in atrophied jaws can achieve similar long-term prognoses as standard dental implants with a reasonable prosthetic design according to this review, stronger evidence is essential to confirm this finding.

Influence of crown-to-implant ratio, retention system, restorative material, and occlusal loading on stress concentrations in single short implants

Sotto-Maior BS, Senna PM, da Silva WJ, Rocha EP, Del Bel Cury AA. Int J Oral Maxillofac Implants. 2012 May-Jun;27(3):e13-8.

Purpose: The aim of this study was to assess the contributions of some prosthetic parameters such as crown-to-implant (C/I) ratio, retention system, restorative material, and occlusal loading on stress concentrations within a single posterior crown supported by a short implant. **Materials and Methods:** Computer-aided design software was used to create 32 finite element models of an atrophic posterior partially edentulous mandible with a single external-hexagon implant (5 mm wide x 7 mm long) in the first molar region. Finite element analysis software with a convergence analysis of 5% to mesh refinement was used to evaluate the effects of C/I ratio (1:1; 1.5:1; 2:1, or 2.5:1), prosthetic retention system (cemented or screwed), and restorative material (metal-ceramic or all ceramic). The crowns were loaded with simulated normal or traumatic occlusal forces. The maximum principal stress (stressmax) for cortical and cancellous bone and von Mises stress (stressvM) for the implant and abutment screw were computed and analyzed. The percent contribution of each variable to the stress concentration was calculated from the sum of squares analysis. **Results:** Traumatic occlusion and a high C/I ratio increased stress concentrations. The C/I ratio was responsible for 11.45% of the total stress in the cortical bone, whereas occlusal loading contributed 70.92% to the total stress in the implant. The retention system contributed 0.91% of the total stress in the cortical bone. The restorative material was responsible for only 0.09% of the total stress in the cancellous bone. **Conclusion:** Occlusal loading was the most important stress concentration factor in the finite element model of a single posterior crown supported by a short implant.

A prospective, randomized-controlled clinical trial to evaluate bone preservation using implants with different geometry placed into extraction sockets in the maxilla

Sanz M, Cecchinato D, Ferrus J, Pjetursson EB, Lang NP, Lindhe J. Clin Oral Implants Res. 2010 Jan;21(1):13-21. Epub 2009 Nov 18.

Aim: The primary objective of this study was to determine the association between the size of the void established by using two different implant configurations and the amount of buccal/palatal bone loss that occurred during 16 weeks of healing following their installation into extraction sockets. **Material and Methods:** The clinical trial was designed as a prospective, randomized-controlled parallel-group multicenter study. Adults in need of one or more implants replacing teeth to be removed in the maxilla within the region 15-25 were recruited. Following tooth extraction, the site was randomly allocated to receive either a cylindrical (group A) or a tapered implant (group B). After implant installation, a series of measurements were made to determine the dimension of the ridge and the void between the implant and the extraction socket. These measurements were repeated at the re-entry procedure after 16 weeks. **Results:** The study demonstrated that the removal of single teeth and the immediate placement of an implant resulted in marked alterations of the dimension of the buccal ridge (43% and 30%) and the horizontal (80-63%) as well as the vertical (69-65%) gap between the implant and the bone walls. Although the dimensional changes were not significantly different between the two-implant configurations, both the horizontal and the vertical gap changes were greater in group A than in group B. **Conclusions:** Implant placement into extraction sockets will result in significant bone reduction of the alveolar ridge.

Impact of diabetes mellitus and metabolic control on bone healing around osseointegrated implants: Removal torque and histomorphometric analysis in rats

de Molon RS, Morais-Camilo JA, Verzola MH, Faeda RS, Pepato MT, Marcantonio E Jr. Clin Oral Implants Res. 2012 Apr 18. doi: 10.1111/j.1600-0501.2012.02467.x.

Objectives: To evaluate bone healing around dental implants with established osseointegration in experimental diabetes mellitus (DM) and insulin therapy by histomorphometric and removal torque analysis in a rat model. **Materials and Methods:** A total of 80 male Wistar rats received a titanium implant in the tibiae proximal methaphysis. After a healing period of 60 days, the rats were divided into four groups of 20 animals each: a 2-month control group, sacrificed at time (group A), a diabetic group (group D), an insulin group (group I), and a 4-month control group (group C), subdivided half for removal torque and half for histomorphometric analysis. In the D and I groups the DM was induced by a single injection of 40 mg/kg body weight streptozotocin (STZ). Two days after DM induction, group I received subcutaneous doses of insulin twice a day, during 2 months. Groups C and D received only saline. Two months after induction of DM, the animals of groups D, C and I were sacrificed. The plasmatic levels of glucose (GPL) were monitored throughout the experiment. Evaluation of the percentages of bone-to-implant contact and bone area within

the limits of the implant threads was done by histomorphometric and mechanical torque analysis. Data were analyzed by anova at significant level of 5%. **Results:** The GPL were within normal range for groups A, C and I and higher for group D. The means and standard deviations (SD) for histomorphometric bone area showed significant difference between group D (69.34 ± 5.00%) and groups C (78.20 ± 4.88%) and I (79.63 ± 4.97%). Related to bone-to-implant contact there were no significant difference between the groups D (60.81 ± 6.83%), C (63.37 ± 5.88%) and I (66.97 ± 4.13%). The means and SD for removal torque showed that group D (12.91 ± 2.51 Ncm) was statistically lower than group I (17.10 ± 3.06 Ncm) and C (16.95 ± 5.39 Ncm). **Conclusions:** Diabetes mellitus impaired the bone healing around dental implants with established osseointegration because the results presented a lower percentage of bone area in group D in relation to groups C and I resulting in a lowest torque values for implant removal. Moreover, insulin therapy prevents the occurrence of bone abnormalities found in diabetic animals and osseointegration was not compromised.

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— It must contain title, abstract, keywords in Portuguese and English.
— Information on the identification of authors (e.g.: authors' full names, academic degrees, institutional affiliations and / or administrative positions) must not be included. They should be included only in specific fields in the article submission website. Thus, this information will not be available to reviewers.

3. Abstract

— Structured abstracts in Portuguese and English of 250 words or less are preferred.
— Structured abstracts must contain the following sections: INTRODUCTION, with the proposition of the study; METHODS, describing how it was conducted; RESULTS, describing the primary results; and CONCLUSIONS, reporting the conclusions of the study and the clinical implications of the results.
— Abstracts must be accompanied with 3 to 5 keywords, also in Portuguese and English, adapted in accordance to DeCS (http://decs.bvs.br/) and MeSH (www.nlm.nih.gov/mesh) guidelines.

4. Text

— Text must be organized into the following sections: Introduction, Material and Methods, Results, Discussion, Conclusions, References and Figure legends.
— Text must have a maximum of 3,500 words, including figure and table legends (excluding the data of tables), abstract and references.
— Figures must be sent in separate files (see below).
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— Tables must be self-explanatory and complementary and not duplicate the text.
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All manuscripts must be accompanied with the following statements to be filled at the time of submission of the article:

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— Use the following examples:

Articles with up to six authors

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Articles with more than six authors

De Munck J, Van Landuyt K, Peumans M, Poitevin A, Lambrechts P, Braem M, et al. A critical review of the durability of adhesion to tooth tissue: methods and results. J Dent Res. 2005 Feb;84(2):118-32.

Chapter of Book

Kina S. Preparos dentários com finalidade protética. In: Kina S, Brugnera A. Invisível: restaurações estéticas cerâmicas. Maringá: Dental Press; 2007. cap. 6, p. 223-301.

Chapter of book with editor

Breedlove GK, Schorfheide AM. Adolescent pregnancy. 2nd ed. Wieczorek RR, editor. White Plains (NY): March of Dimes Education Services; 2001.

Dissertation, thesis and completion of course work

Beltrami LER. Braquetes com sulcos retentivos na base, colados clinicamente e removidos em laboratórios por testes de tração, cisalhamento e torção [dissertação]. Bauru (SP): Universidade de São Paulo; 1990.

Electronic format

Câmara CALP. Estética em Ortodontia: Diagramas de Referências Estéticas Dentárias (DRED) e Faciais (DREF). Rev Dental Press Ortod Ortop Facial. 2006 nov-dez;11(6):130-56. [Accessed on 2008 Jun 12]. Available at: www.scielo.br/pdf/dpress/v11n6/a15v11n6.pdf.