STUDY ON STABILITY OF DENTAL IMPLANTS IN PATIENTS WITH OSTEOPOROSIS

Barbu Horia Mihail¹, Comăneanu Raluca Monica¹, Ghergic Doina Lucia¹, Dumitrache Constantin²

¹ Faculty of Medicine and Dental Medicine, Titu Maiorescu University, Bucharest
² Faculty of Medicine, Carol Davila University, Bucharest

Address for correspondence:
Horia Mihail Barbu,
str. Turda nr 122, bl.39, sc.B, ap. 47, București
e-mail: horia.barbu@gmail.com.

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Abstract

Introduction to the theme and aims: A compromised bone metabolic system may be a risk factor in obtaining dental implant osseo integration and then in maintaining it on decades of clinical functionality. The aim of our study is to investigate and improve implants stability according to their size and shape, but also with respect to the biomechanical properties of the bone.

Methods: We studied two groups of patients, group A consisting of patients osteoporosis free, and group B consisting of patients with osteoporosis. The estimation of the quality of the bone and of the risk of implant failure has been achieved after carrying out several investigations, including on the determination of the bone turn-over by measuring Beta Crosslaps (B-CTX) Telopeptides. For the patients in group A, considered as the control group, surgical protocols specific for clinically healthy patients were applied. The patients in group B have replaced the classic treatment with bisphosphonates for 3-12 months with strontium ranelate (Osseor, Les Lab. Servier Ind., France), in order to avoid complications such as osteonecrosis. The set of laboratory investigations was repeated every 3 months, and the surgical interventions for the insertion of the dental implants were made when we have found the transition of the Beta Crosslaps value above the 150 pg/mL threshold. We made use of the Resonance Frequency Analysis (RFA) every 3 weeks to monitor the variation of the curve by ISQ values (implant stability quotient) from the beginning (primary stability), until obtaining the osseointegration. After prosthetic loading, ISQ registration was performed quarterly for a period of 1 year.

Results: Although the ISQ index initially had a greater value (69-87 in group A, respectively 51-64 in group B), it was observed that in the first 2 months after the implant insertion the ISQ value showed a significant decline and over the next 4-6 months the implant's stability coefficient increased but failed to reach its initial values. These initial values are equal or even greater in about 8-10 months after the prosthetic loading.

Discussions: The interdisciplinary collaboration between the endocrinologist specialist, dental implantologist and protetician is essential to improve the long-term prognosis of prosthetic implants treatments applied to patients with osteoporosis. Osseor administration for 9-12 months has clearly improved primary stability in subjects belonging to group B and in none of the cases was found the installation of osteonecrosis.
Keywords: dental implant, osteoporosis, primary stability, osseointegration, osteonecrosis.

Introduction to the theme and aims

The compromised bone metabolic system may be a risk factor in obtaining dental implant osseointegration and then in maintaining it on decades of clinical functionality. One of risk of is osteoporosis (OP), which though is affecting a growing number of women and even men, it is less studied, especially in terms of inter-connection between the OP bone and the dental implant. In osteoporosis, the implant stability may be compromised due to structural changes in the bone, which considerably reduce the chances of the osseointegration [1].

The aim of our study is to investigate and improve the stability of implants according to their size and shape, but also with respect to the biomechanical properties of the bone.

Methods

We studied two groups, A and B, consisting of patients who were sent to our clinic during July 2007 and March 2011, in order to carry out prosthetic implants treatments. Both groups were selected from among patients aged 42-73 years old. Group A consisted of 103 patients osteoporosis free, in which a number of 372 implants were inserted (Touareg, Adin, Israel), while group B included 131 patients with osteoporosis, in which 469 implants were inserted (Touareg, Adin, Israel).

In order to identify patients with OP presenting an increased risk of implant failure, they were subjected to an investigation protocol which included: measurement of the bone mineral density (Dexa), Cone Beam CT (CTCB), bone density determination by using the „SimPlant Master Cristal” program (Materialise Dental, Belgium) (Fig.1), determining the bone turn-over by measuring the Beta Crosslaps telopeptides (B-CTX). These investigations allowed us to appreciate the qualities of the implant recipient bone and to select the appropriate implant to each clinical case in terms of length, diameter, macro and micro-geometrics, with a view to obtaining the maximum possible primary stability.

For an accurate assessment of the implant stability and of the osseointegration development over time, we conducted measurements during and after surgery using Resonance Frequency Analysis (Ostell AB, Sweden), for both groups of patients (Fig.2).

All patients in group B in which the measured value of Beta Crosslaps was below 150 pg/mL have dropped the bisphosphonates treatment or they have been replaced by the endocrinologist specialist with strontium ranelate (Osseor, Les Lab. Servier Ind., France) for a period of 3 to 12 months, in order to avoid the occurrence of osteonecrosis of the jaw that can occur in osteoporotic patients following the treatment with bisphosphonates [2].

Osteonecrosis of the jaw is an uncommon, but severe, adverse event associated with oral and intravenous bisphosphonate therapy. The effects of bisphosphonates reduce the phenomenon of bone repair by promoting the development of osteonecrosis and osteomyelitis areas. Angiogenic properties in that area emphasize the ischemic effect [3,4]. Bisphosphonates also produce an inhibitory effect on cell cycle of keratinocytes, which also affects the local mucosal repair mechanisms [5,6,7].

Marx noted an increase in B-CTX ranging from 25.9 pg/ml and 26.4 pg/ml for each month of interruption in the administration of bisphosphonates [2].

In group B patients we carried out further analysis every 3 months. The average increase in the value of B-CTX that we have observed in group B patients is 23 pg /ml each month. Thus, from initial value of 90 pg/ml a period of four months waiting was needed in order to exceed the threshold value of 150 pg/ml that would allow performing surgical interventions.

Results

The implants were inserted into the bone with a precise torque force, using a dynamometric wrench. Mean values measured during the operation were of 35-70 N/cm in group A patients and of 15 to 30 N/cm in group B patients.

Regarding the selection of the implant, macro-geometrics play an important role in obtaining the initial mechanical fixing. Thus, implants with wide, aggressive and rare turns (Fig.3) are fitted nicely in porotic bone [8].

Resonance Frequency Analysis (RFA) was used to monitor the values of the curve by ISQ index (implant stability quotient) from the beginning (primary stability), until obtaining the implants osseointegration (Fig.4). Throughout this period, the ISQ values were recorded every 3 weeks. After
completion of the prosthetic loading, ISQ value was recorded quarterly for a period of one year.

Mean value measurements with RFA ranged from 69-87 ISQ in group A and in group B ranged between 54-69 ISQ.

At 1 month after surgery, the RFA values measured in group A patients were significantly decreased (by 20%), while in group B the values were slightly reduced (by 5-8%).

At 8-10 weeks after surgery, the RFA in group A started to increase and stabilized with the completion of the bone healing at 6 months post-operatively at around 71-76 ISQ, which allowed to complete the prosthetic phase of the treatment.

After an initial slight decrease, the RFA values in group B patients started to increase (from 51 to 57 ISQ), but these values were not an indication of the prosthetic loading, as the minimum acceptable value for the implants prosthetic loading is of 65 ISQ [9].

Therefore, for the patients in group B it was decided to delay the prosthetic loading and to continue in monitoring the implant stability for another 2-6 months. At the end of a six months monitoring (12 months from the surgical implant-prosthetic treatment), the measurements indicated ISQ values of more than 65 to 93% of the total number of implants inserted in group B patients.

Discussion

The values measured intraoperatively by manual torque wrench can only reveal the initial value of the mechanical primary stability. On the other hand, by using the dynamometric wrench, the stability can be measured only once, namely when inserting the implant.

Mean value of the implant stability, measured by long-term RFA is of 70 ISQ. A high initial value of ISQ (70-90) does not increase during the next months; however it is natural to record a slight decrease until the initial mechanical stability will be replaced by the biological one. A big or a constant drop in the value (more than 2 months after surgery) may be a sign of osseointegration failure.

We found differences in the ISQ values in the group B patients, with respect to the absence (53-64 ISQ) or the presence (55-71 ISQ) of a general treatment at the time of the surgical intervention. We also observed an increase in the bone density 12 months after the treatment with Osseor 2g/day in patients who were initially treated for osteoporosis.

Figure 1. Determination of bone density with SimPlant (Determinarea densității osone cu ajutorul SimPlant)

Figure 2. Initial implant stability measured by RFA (Stabilitatea implantară inițială măsurată cu ajutorul RFA)

Figure 3. Implant with aggressive, rare turns, fix nicely in osteoporotic bone (Implant cu spire agresive, rare, se fixează foarte bine în osul osteoporotic)

Figure 4. Intraoperative measurement of primary stability with RFA (Măsurarea stabilității primare intraoperator cu ajutorul RFA)
The values of the stability in cases where they were initially very low have increased by 20%.

In the case of smooth variations in the implant stability, it is difficult to take a decision regarding the retention or the removal of the implant [10]. The primary and secondary stability determination has been used in our study as an indicator of future success in osseointegration. It is also very important to establish a protocol to follow regarding the timing of the implant loading [11].

Osteoporotic patients which starting therapy with oral or intravenous bisphosphonate for prevention or treatment of osteoporosis should be informed about the rare risk of jaw osteonecrosis [12].

Conclusions

By changing the general medication by your endocrinologist we have avoided the installation of osteonecrosis.

The collaboration between the physician endocrinologist, implantologist and the protetician is essential in the early diagnosis of osteoporosis, in the recommendation of a treatment as soon as possible so that a long-term prognosis of implants-prosthetic treatment would be the best possible.

The treatment plan in patients with OP is different, with a high degree of difficulty than that of patients OP free. It seems to us that in order to obtain the primary stability and the osseointegration of the implants in OP patients, it is necessary that their macro-geometrics has large, rare and active loops, and in terms of implant surface treatment, very good results have been achieved with implants with rough and bioactive surfaces. The chosen implant size must provide the primary stability and need to comply with the principle of minimally invasive surgical interventions.

References


