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Three ways of predicting the implant primary stability: Torque, ISQ and bone density accessed by CBCT. Results of Randomised Controlled Trial (RCT).

RAQUEL ZITA GOMES, ANTONIO FELINO, LAURA SILVA, JOAO COIMBRA, ANDRE CORREIA, RICARDO TAVARES, MARIO VASCONCELOS

Introduction

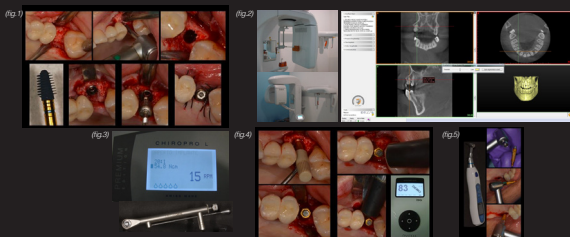
The success of oral rehabilitation depends on the amount and quality of available bone. (1) Cone-Beam Computerized Tomography (CBCT) manages to determine the bone density in Hounsfield Units (HU) and to classify it, according to Misch's 5 bone-type scale. (1,2) Implant stability may be assessed non-invasively through the implant torque test or radio-frequency analysis (RFA), which evaluates the stiffness of the bone/implant complex. (2)

Objectives

The present RCT main aim is to evaluate whether a relationship between the amount of bone density, measured by means of CBCT in the preoperative phase, the value of insertion torque during implant placement and the implant quotient stability (ISQ) measured by radio - frequency (Osstell®) after implant placement exists.

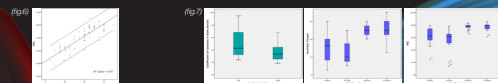
Materials and Methods

Forty patients were initially gathered and the initial sample was composed of 105 implants (Anyridge, Megagen®), placed following a conventional protocol of one or two stage surgeries. (fig. 1) Inclusion criteria included oral rehabilitation clinical cases with an indication of one or more implants in edentulous areas not previously regenerated with complementary diagnostic test CBCT with the possibility of analysis of bone density (by SimPlant Pro 15 software) and measurement of torque and ISQ during the implant placement. Exclusion criteria include patients with no controlled systemic diseases and with pharmacological therapies that can alter bone metabolism. After the application of inclusion and exclusion criteria the final sample was composed by 79 implants placed in 28 patients. Bone density of the precise implant location was assessed pre-surgically through CBCT, according to the Hounsfield scale (D1 to D5), through SimPlant Pro 15 program. (fig. 2) Implant torque was determined during implant surgery with a Bienair® motor with a 20:1 reduction and/or the help of an implant calibrated torque key. (fig. 3) RFA was expressed by the implant stability quotient (ISQ), evaluated through Osstell® analysis on two perpendicular assessments (V-L and M-D). (fig. 4) The specific Anyridge smartpeg to ISQ measure was screwed using a special instrument inserted in Meg-Torque® (Megagen, Gyeongsang, Korea) portable engine calibrated at 10 N/cm. (fig. 5)



Results and discussion

Through Spearman correlation, we found a statistically significant correlation for the three relations. The coefficient of variation of bone density obtained a value of $r_s = -0.322$ ($p = 0.01$) correlation with the insertion torque and $r_s = -0.296$ ($p = 0.005$) with the ISQ ($p = 0.010$). ISQ showed correlation value $r_s = 0.834$ ($p < 0.05$), with the insertion torque. Also, the results from this study found a strong association between the ISQ and torque which allowed, by linear regression, the establishment of a formula ($ISQ = 51.51 + 0.49 \times \text{torque}$) that allows the prediction of one of the variables according to the other in about 74 % of cases. Thus, for example, a torque of 50 N/cm prediction is ISQ 76 ($ISQ + 0.49 = 51.51 \times 50 = 76$). (fig. 6) Non-parametric tests employed for implant samples placed on the upper and lower jaw have shown statistically significant differences between bone density, implant torque and ISQ ($p < 0.01$). (fig. 7 - graphics) Pre-operative bone density assessment appears to be of major importance, allowing to predict the implant primary stability coordinates (torque and ISQ).



Conclusion

In our sample we proved the existence of a strong positive correlation and statistically significant ($p < 0.05$) among the three variables: bone density measured in CBCT (preoperative), insertion torque and ISQ at implant placement. The bone density measurement of the receptor site can be a criterion for predicting the implant's primary stability, making it an excellent diagnostic tool. The sum of the data values of the three variables (CBCT bone density, insertion torque and ISQ) provides an objective and measurable bone quality information as well as protocols (guidelines) to support clinical decisions. Within the limitations of this study, concerning Anyridge implants placement, pre surgical CBCT mineral bone density assessment might allow one to predict implant's future stability. Of course, in the future more research is needed on this topic.

References

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- Bayarchimeg D et al. Evaluation of the correlation between insertion torque and primary stability of dental implants using a block bone test. JPIS. 2013;43(1):30-6.