THE IMPORTANCE OF BONE QUALITY AND BONE LOSS IN THE DENTAL IMPLANT STABILITY: AN EXPERIMENTAL STUDY

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ABSTRACT

The absence of a tooth is a recurring problem due to functional and aesthetic changes; solutions are increasingly to solve this problem. With technological advances, the dental implant has become the frequent and preferred solution. The success rates of the implantation are very high; however, there are still a few cases of failure. The main objective of this study is to assess the relationships between the dynamic stability of the implant and bone density or bone loss. A commercial implant was selected and tested with different types of polyurethane foam bone.

The test was carried out at a speed of 1 mm/minute up to 355 N in compression at 14\degree in vertical, with maintenance of the force for 60 seconds and relaxation thereafter. It was found that with increasing bone density, the stability of the implant increases. It was also confirmed that with increasing bone loss, the stability of the implant is reduced manly in lower bone density. In conclusion, the bone quality around the implant strongly influences the success rate.

Keywords: dental implant, implant stability, bone loss, bone density.

INTRODUCTION

Dental implants are a frequent procedure in developed countries and an increasingly used solution in the event of loss of a tooth (Egget and Levin, 2018). The main cause of implant failure are peri-implants, which generate infection and bone loss; another critical aspect is the lack of bone integration after implantation (Kullar and Miller, 2019, Smeets et al., 2016). The initial stability of the implant is crucial for its success and is closely associated with the density of the bone in which the implant is inserted (Meffer et al., 1992). In this study, two situations were analysed, the influence of bone density on primary stability and on proximal bone loss. To test the effect of bone density, three types of cancellous bone made of open polyurethane foam were used. The density tested was D20, D15 and D10 (where 10 is the density in pounds per cubic foot) in open cell bone. To test the effect of bone loss in the proximal region of the implant, a loss of 0.2 mm per year was taken into account (Linetski et al., 2017) from the upper surface, multiplied by the duration of implant life. In this case, bone loss was studied after 5 and 10 years after implantation, which is equivalent to 1 mm and 2 mm of bone loss proximally.

To define the geometry of the bone, a layer of 2 mm around the implant and 40 mm in length was considered. The implant tested, shown in Figure 1, is a Branemark model at a 3: 1 scale, with 31.5 mm in length and 12 mm in diameter. The implant was self-screwed with a torque controlled at 0.9 N.m. The compression load was tested at 14 \degree representing the load on the teeth (two components) in the vertical direction and the test was carried out at a speed of 1 mm /minute up to 355 N in compression, maintaining this force for a total of 60 seconds before relaxation. The tensile tests were performed in the axial direction to verify the implant removal test.
RESULTS AND CONCLUSIONS

The results emphasize the importance of bone density in the stability of the implant. Bone density is important and stability decreases with decreasing bone density, but this effect is critical with bone density D10 when the bone after the test does not regain its elasticity; for the other densities, the behaviour is similar.

Relatively to the effect of bone loss, Figure 2 shows the effect of bone density D15. The results show a decrease in stability with proximal bone loss; this effect is more pronounced when the density is lower and for 10 years when the implant loses 58% of its initial stability. The results highlight the effect of bone density on the stability of the implant affecting the maximum load during the tensile test for the same implant. The results have more effect for a bone density lower than 15 PFC and must be confirmed with implant geometry, such as a conical geometry.

REFERENCES