SUMMARY

Measurement of primary stability of the dental implant and the influence of the implant design

Primary stability is the lack of mobility in the bone after an implant insertion and it is conditioned by the quality and quantity of the bone, the surgical technique and the skill of the surgeon. Another element is the micro-design and especially macro-design of the implant, whose influence on the primary stability has not been given sufficient scientific attention.

The objective of this report is to analyze the influence of the most commonly used threads for implant stability findings a stress distribution at the interface of the implant - bone and adjacent periimplant bone and mechanical load transfer from the implant to the surrounding bone (mechanical compatibility) for these types of threads. Another objective is the theoretical use of the Finite Element Analysis (FEA) which is used to analyze the influence of the length and diameter of the implant on the primary stability. The practical application is based on clinical studies that have shown a link between the length and diameter of the implant on one side and the primary stability on the other.

The results obtained by the FEA confirms that the thread shape of the implant influences the resulting mechanical stress on the bone and the implant, but does not clearly identify the most appropriate type of implant thread.

It was further discovered that in the mathematical model, the most appropriate frequency for a vibrating implants rose almost linearly, which suggests that with increasing length and increasing diameter the implant will increase the primary stability. One exception is the mean of 3.7 mm and length 16 mm. At this diameter, the length when extended affects more weight than the stiffness of the implant.

Clinical study results have shown that the length and diameter have a positive effect on the primary stability of the implant, but it is not possible to clearly define which of these parameters have a decisive influence on the resulting stability of the implant. Further clinical studies have shown that additional parameters such as gender, age, type of jaw implant position and the elapsed time from extraction to implantation do not have a significant impact on the primary stability. The exceptions are women in the age group "56 and older" due to osteoporosis which exacerbates the primary stability of the implant.

From these results, it is clear that measuring the stability of the implant by using Resonance Frequency Analysis (RFA) has limited assurances. Firstly, the proper frequency and mode the implant - bone system may lie outside the measurable range of Osstell® and secondly, the resulting values of stability measured by the RFA can be affected by rigidity and weight of the implant. It is clear that the future design of the implants is in reducing the overall rigidity, so that the best possible mechanical compatibility will be between the implant and the bone.

The central focus of this thesis lies in the connection of modern methods of biomechanics with clinical practice. It has been demonstrated that the FEA which is a suitable method for modeling and assessing conditions, which are difficult to measure *in vivo*, has limitations. These particular difficulties reveal all the characteristics of the bone to its inhomogeneity. Therefore, specific numerical model of bone is necessary for the continuation of research.