

# A Machine Learning Approach of the Prediction of Tissue Differentiation for Dental Implants

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## Abstract:

Dental implants are widely used for biomedical applications. The design of structure determines the efficiency of bone ingrowth and osseointegration. In order to enhance the osseointegration and long-term survival rate of implants, we performed a two-dimensional axisymmetric finite element model which is based on mechano-regulation algorithm to predict the tissue differentiation and the performance of the implant. However, the main drawbacks of FE simulation to predict bone ingrowth are huge memories required and computation time. Thus, it is necessary to develop a more efficient method enabling the application to the clinical medical industry.

In the current work, a model using machine learning techniques to accelerate the numerical prediction of tissue differentiation around the implants. The results of 65 implants with different design, generated by the FE mechano-regulation model are used to as the training data of the machine learning. The results of tissue differentiation from machine learning predictions have very good agreements with those provided by the database. The Pearson's correlation coefficient between theoretical values and machine learning predictions are up to 98% in all the important physical parameters considered in the FE model. The machine learning model developed in this work is accurate and efficiency, which can be applied to clinical dental implant surgery.

## Keywords:

Machine learning; Mechano-regulation algorithm; Finite element method; Tissue differentiation; Dental implant; Osseointegration; Bone healing