Preoperative Evaluations of Dental Implants and Bone Healing Prediction by Deep Learning Network

NCKUES Seminar

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越生講堂

成大工科系館
地下一樓

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Abstract:

Evaluation of the performance of dental implants is essential for clinic surgery. In recent decades, a complex biomechanical theory, known as mechano-regulatory method, has been used to predict the performance indexes of implants numerically, such as bone area (BA) and bone-implant contact (BIC). However, the method requires hours of calculation and provide no direct design suggestions for implants. In the present study, we proposed a workflow comprised of a series of machine learning algorithms (mainly deep neuron networks) to be an alternative to mechano-regulatory method. This deep learning network (DLN) successfully predicted bone healing history around implants within seconds. The Pearson correlation coefficients were used to measure the of degree of interrelationship between predicted results and mechano-regulatory method. The correlation coefficients of the predicted essential physical properties of surrounding bones (e.g. strain and fluid velocity) and performance indexes of implants were greater than 0.980 and 0.947, respectively. It is remarkable that the current DLN predicted the time-series results with dataset of 65 different implants only which was generated by mechano-regulatory method. Moreover, by applying Deep Taylor decomposition (DTD) to the portion of DLN, it is suggested that the upper and lower parts of dental implants have a higher influence on the overall bone healing compared to the middle part, having good agreement with the design strategy in the commercial implants. The current DLN enables an instant evaluation of dental implants which has great potential to be applied to dental clinics. This work is also a proof of concept that DLN with proper network design is capable to replace complex, time-dependent, multi-physical models/ theories, as well as to reveal the underlying features without clinical expertise.

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Place: 成大工科系系館 地下一樓 越生講堂 Time: 14:10 -15:30