Synopsis of Original Research Paper

Development of innovative support system for maxillofacial prosthesis using deep learning

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Maxillofacial prosthetic rehabilitation replaces missing structures to recover the function and aesthetics relating to facial defects or injuries. Deep learning is rapidly expanding with respect to applications in medical fields. In this study, we apply the artificial neural network (ANN)-based deep learning approach to coloration support for fabricating maxillofacial prostheses. We prepared 52 silicone elastomer specimens of varying colors and measured the CIE 1976 L* a* b* color space information using a spectrophotometer and an application for mobile device. We constructed the deep ANN using Python and implemented it using the Keras with TensorFlow as the backend. The deep ANN architecture consisted of three input variables, two hidden layers with 1000 nodes, and four output variables. The output of these algorithms indicated the compounding amount of four pigments. According to the algorithms' pigment compounding predictions, we prepared the specimens for validation analysis and measured the CIE 1976 L* a* b* values. We determined the color differences between the real skin color of ten research participants and that of the silicone elastomer specimens fabricated based on the algorithm predictions using the CIEDE00 ΔE_{00} color system. The color differences (ΔE_{00} value) between the real skin color and silicone elastomer validation specimens were 3.45±0.87 (the algorithm trained using values of specimens measured with a spectrophotometer) and 8.93±3.65 (the algorithm trained using values of specimens measured with an application for mobile device), which indicates that the deep ANN approach produced superior results with respect to the ΔE_{00} value. These results suggest that applying deep ANN is a promising technique for the coloration of maxillofacial prostheses.