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A Study on the Development and Application of Image-based Facial Skin Aging Diagnosis Technology Using A.I. Model

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Introduction:

Image analysis using artificial intelligence (A.I.) technology is being used in various fields [1], and the demand is increasing with the development of skin research, cosmetics industry, and personalization services [2][3]. In particular, methods of using A.I. model that learned facial image for quantitative evaluation of facial skin aging have been attempted [4][5], but the correlation with human skin aging recognition and the suitability for skin aging research have not been confirmed.

In this study, we developed an image-based facial aging diagnosis system to evaluate the overall facial skin aging with intuitive and quantified age levels using deep learning technology, and confirmed the correlation with the clinical expert's judgement.

Materials & Methods:

▶ Materials for developing the A.I. facial skin aging diagnostic system (Dr.AMORE): 11,000 facial images collected from Korean volunteers aged 19 to 79 years.

▶ Development of system

· The proposed system uses SSR-Net (Soft Stagewise Regression Network) as a backbone and is further devised to be more appropriate for our domain dataset.

· To increase the robustness on various conditions, the face position information is transmitted as well as the facial image to the system.

▶ System verification: 2,000 facial images were used for development tests / 160 facial images were used by five clinical experts to determine the correlation between human facial aging cognition and the results of this system.

▶ Application to research: 1) Long-term skin aging study 2) The efficacy evaluation study of anti-aging cosmetics.

Results:

■ The AI system's predicted age showed a difference of biological age and ±3 years old, and it showed a significant correlation with the perceive facial age determined by five clinical experts (Table 1).

		ICC (95% confidence interval)	p-Value
AI predicted age - Clinical Experts	AMI	0.928 (0.728, 0.969)	<0.001

*Average measures Intraclass

Table 1. ICC value for AI predicted facial age compared to clinical experts.

■ The result of evaluating images of participants who used anti-aging products with syringaresinol, hydrolyzed ginseng saponins, and bioflavonoids as the main active ingredients, it was showed that the predicted facial age after 8 weeks of use was significantly lowered compared to before use (Figure 1).

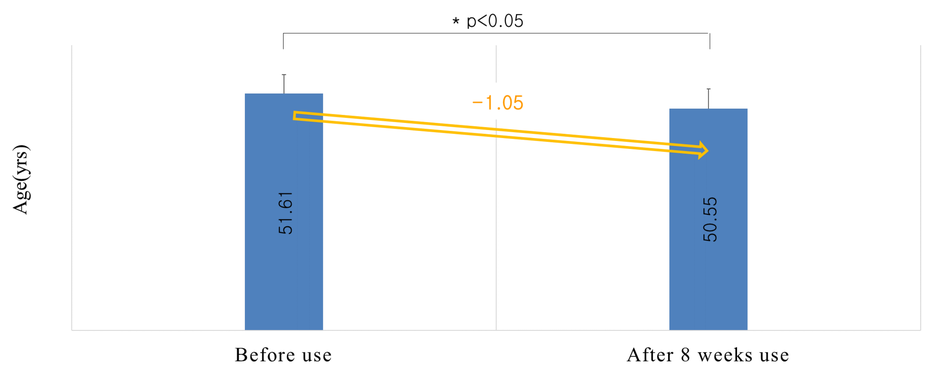

Figure 1. Predicted facial age results of participants who used anti-aging cosmetic products.

■ The aging degree of the participants was quantified by analyzing the aging of the entire face in the 4-year long skin aging study. The group using retinol-containing products, anti-aging components, showed lower predicted facial age than the control group without use after 4 years (p<0.1). The changes in the predicted age of the face within the group was also lower (Figure 2).

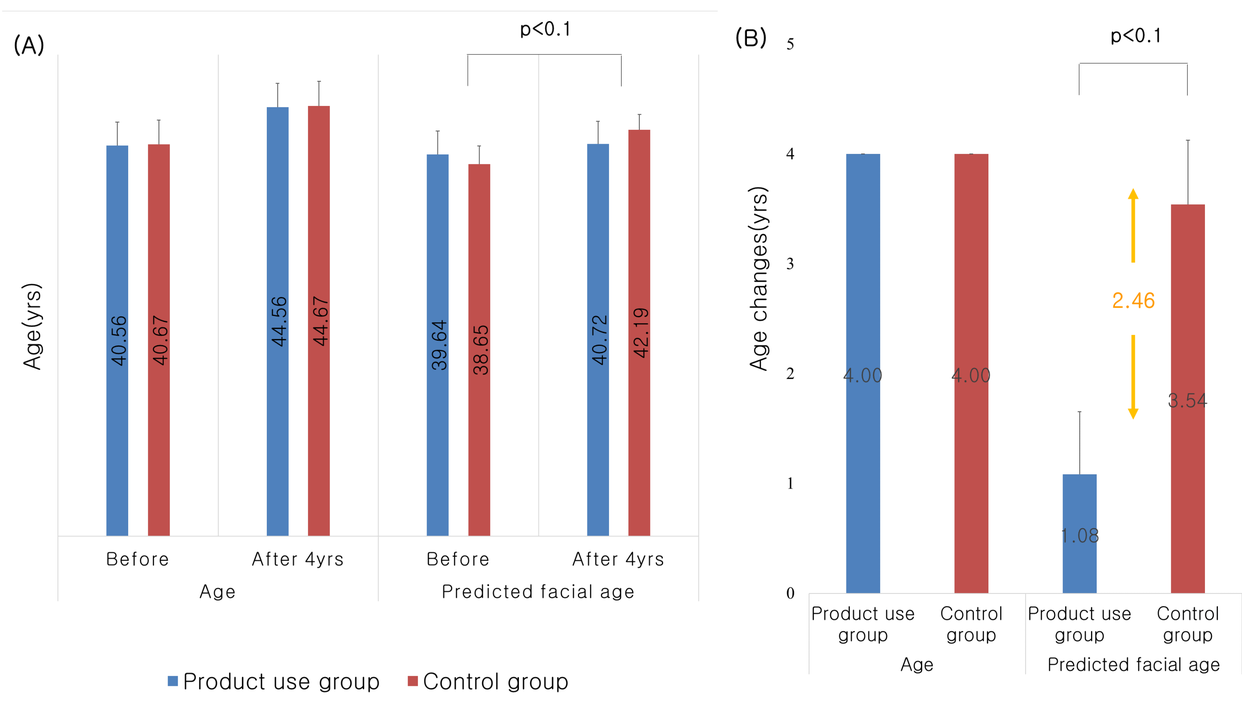

Figure 2. (A) Comparison result of product use group and control group for the age and predicted facial age.
(B) Comparison result of increased age between product use group and control group.

Discussion:

The facial skin aging diagnosis system developed by deep learning can evaluate overall facial skin aging changes using only an optical facial image like as clinical experts and predict facial skin age based on this result. In addition, the prediction facial age of AI system is expected to be useful in long-term facial skin aging studies. We also evaluated the efficacy of anti-aging cosmetics, and participants using anti-aging products were able to identify significantly lower facial skin ages compared to before use.

Conclusions:

Our facial skin aging diagnosis system was verified by comparison with expert evaluation and it showed high accuracy. In addition, the system has the advantage of being able to evaluate the entire face more objectively, consistently, and at a faster and lower cost than conventional skin evaluation equipment of visual assessments of experts. And it is expected to be useful for skin aging research or cosmetic efficacy evaluation for anti-aging.

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