Facial Plastic Surgery & Aesthetic Medicine
Volume 0, Number 0, 2021

DOI: 10.1089/fpsam.2020.0560

Facial Plastic Surgery
&Aesthetic Medicine

Turning Back the Clock with Lip Lift: Quantifying Perceived Age Reduction Using Artificial Intelligence

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Introduction

The lip lift (LL) is an increasingly popular procedure for perioral rejuvenation. To study the implications of shortening the upper lip height on perceived age, we utilize artificial intelligence (AI) as a novel tool for quantifying such changes.

Methods

An LL was simulated on patient photos (range 37–63; average 51) at 3, 5, and 7 mm intervals (Fig. 1).[1–3] Adobe Photoshop pixels were calibrated to millimeters, and the following heights were measured: philtrum (subnasale to white roll), upper lip (subnasale to stomion), and vermilion (white roll to stomion). All photos were analyzed with Microsoft Azure: Face (Microsoft Corp.), using a two-tailed paired *t*-test (significance represented $p<0.05$).

Results

Baseline analysis showed an average AI age of 41.9 ± 5.5, with philtral and upper lip heights of 17.02 and 21.94 mm, respectively. Perceived age decreased in all patients: 3.2% ± 3.1% ($p=0.002$), 6.8% ± 3.3% ($p<0.001$), and 7.7% ± 4.4% ($p<0.001$) for 3, 5, and 7 mm, respectively) (Fig. 2a). The youngest patients (perceived age <35 years) exhibited the largest reductions in age for all intervals (3, 5, and 7 mm): 6.9% (2 years), 10.3% (3 years), and 17.2% (5 years) (Fig. 2b). The percentage reduction in perceived age was less for the other age groups: 35–39 (2.7%, 4.5%, and 6.3%), 40–44 (3.9%, 8.2%, and 9.2%), and 45–49 (2.1%, 5.9%, and 5.1%). The extent of reduction in perceived age had a strong positive correlation with total reduction in philtrum height ($N=56$, $r=0.54$, $p<0.001$), as well as a smaller philtrum height ($N=42$, $r=0.51$, $p<0.001$). In addition, as philtrum/vermillion ratio increased, patients were perceived as older ($N=14$, $r=0.44$, $p=0.11$ for baseline; $N=42$, $r=0.47$, $p=0.002$ for LL increments).

Discussion

It is believed that a shorter lip appears more youthful and thus understanding the effect that surgical LL can have on perceived age has clinical value.[4] This study is the first to our knowledge that explores the isolated impact of upper LL on perceived age using AI.

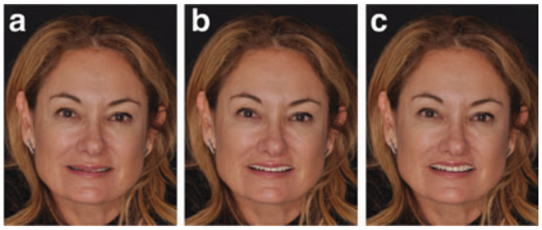

Fig. 1. Simulated lip lift with indirect technique. A selection of upper lip lift is displaced upward using the indirect technique to create **(a)** baseline, **(b)** 3 mm lip lift, **(c)** 5 mm lip lift, and additional 7 mm increment. For the analysis, the teeth were removed from the mouth to create a white space.

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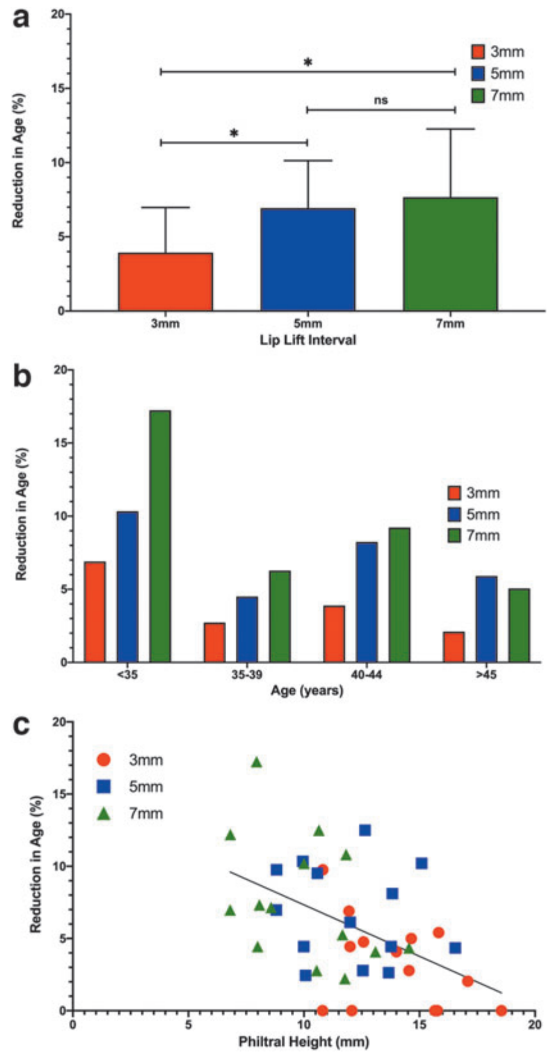

Fig. 2. Percentage reduction in age for increasing lip lift intervals, age groups, and philtral height. **(a)** This graph shows the mean reduction (%) (±1 SD) in age after increasing lip lifts (3, 5, and 7 mm). $N = 14$ for each interval. Significant differences ($p < 0.05$, two-tailed paired t-test) between lip lift intervals are indicated by (*), whereas differences that do not reach significance are denoted by (ns). **(b)** This graph shows the mean reduction (%) in age for each lip lift interval grouped by initial age (years). **(c)** These scatterplots show the reduction in age (%) and philtrum height (mm) for increasing lip lift intervals. The x-axis shows philtrum height. The y-axis displays percentage reduction of initial age. The data are displayed with a linear regression ($N = 42$, $r = 0.51$, $p < 0.001$). SD, standard deviation.

In this initial study, we chose to analyze computer simulations of LL on a single image, rather than comparing pre- and postoperative photographs. Simulations on a baseline image avoids confounding variables such as microexpression, lighting, and related issues.[5] The teeth were removed in our photos to eliminate the potential impact of dental aesthetics on perceived age.

Using AI, we found that LL leads to a decrease in age that is proportional to the extent of LL performed. Interestingly, our data indicated that the impact of LL may be greatest on a younger-aged-patients (<35 years) (Fig. 2b), with the second largest difference seen in patients 40–44 years old.

Interestingly, Microsoft Azure consistently quantified the baseline age as younger than the actual age. A potential explanation is that cosmetic patients self-select for individuals who give more attention and care to overall appearance. To control for this difference in this study, all comparisons were made between perceived ages.

One important factor in considering LL is the philtrum/vermillion ratio. Raphael et al. previously described the ideal ratio as 1.2 to 2.3 with a ratio greater than 3 indicating a long upper lip.[6] Our data support this claim showing a positive correlation between the philtrum/vermillion ratio and increased perceived age. In this study, we only changed philtrum height, but future studies may explore how combined approaches such as adding height and/or volume to the vermillion may affect age perception.

Conclusions

AI software demonstrated a reduction in age for incremental LL. The largest percentage decrease in age was found in patients <35 years. The utility of AI software may be expanded to analyze age for blepharoplasty and neck lift. Future studies may combine multiple aesthetic procedures to assess how each combination reduces age compared with isolated procedures.

Authors' Contributions

Conceptualization, methodology, simulation, analysis, and writing—original draft and editing by A.R.G. Conceptualization and writing—reviewing and editing by J.E.S. Conceptualization, methodology, and simulation by S.C.T. Data acquisition by S.F. Analysis by R.D. and S.S. Conceptualization and analysis by J.R. Conceptualization, methodology, and writing—original draft by J.B.L. Conceptualization, methodology, analysis, simulation, and writing—reviewing and editing by O.M.T. All coauthors have reviewed and approved of the article before submission.

Author Disclosure Statement

No competing financial interests exist.

Funding Information

No funding was received for this article.

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